U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

PROCEEDINGS

OF THE

TENTH ANNUAL CONVENTION

OF THE ASSOCIATION OF

American Agricultural Colleges and Experiment Stations

HELD AT

WASHINGTON, D. C., NOVEMBER 10–12, 1896

EDITED BY

A. C. TRUE, for the Office of Experiment Stations

AND

H. H. GOODELL, for the Executive Committee of the Association

WASHINGTON

GOVERNMENT PRINTING OFFICE

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† President of board of direction.
‡ Assistant director in charge.
§ Chairman of council.
‖ Secretary.
¶ Acting director.

CONTENTS.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 9, 1897.

SIR: I have the honor to transmit herewith for publication Bulletin No. 41 of this Office, containing the proceedings of the Tenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 10–12, 1896.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

OFFICERS AND COMMITTEES OF THE ASSOCIATION.

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Revising Constitution of Association:

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H. E. ALVORD, of Washington, D. C.

Nomenclature:

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G. MCCARTHY, of North Carolina; F. W. CARD, of Nebraska;
W. R. LAZENBY, of Ohio.

LIST OF DELEGATES AND VISITORS IN ATTENDANCE.

Alabama:

College: P. H. Mell, professor of botany and geology.

Station (Auburn): F. S. Earle, horticulturist and biologist.

Arkansas:

Station: R. L. Bennett, director and agriculturist; G. L. Teller, chemist; W. H. Langford, trustee.

Colorado:

College: J. W. Lawrence, professor of mechanical engineering.

Station: John J. Ryan, trustee.

Connecticut:

College (Storrs): B. F. Koons, president.

Station (New Haven): S. W. Johnson, director; A. L. Winton, chemist.

Station (Storrs): W. O. Atwater, director; C. S. Phelps, agriculturist and vice-director.

Delaware:

College: G. A. Harter, president; W. H. Bishop, professor of agriculture and biology.

Station: A. T. Neale, director; G. H. Powell, entomologist.

Florida:

College: O. Clute, president.

Georgia:

College: H. C. White, president.

Station: R. J. Redding, director.

Illinois:

College: A. S. Draper, president.

Station: E. Davenport, director.

Indiana:

College: J. H. Smart, president; W. F. M. Goss, professor of experimental engineering.

Station: C. S. Plumb, director; H. A. Huston, chemist.

Iowa:

College: J. B. Hungerford, trustee.

Station: J. Wilson, director.

Kansas:

College: G. T. Fairchild, president.

Station: C. C. Georgeson, agriculturist; S. C. Mason, horticulturist.

Kentucky:

College: J. K. Patterson, president; F. P. Anderson, professor of mechanical engineering; C. W. Mathews, professor of agriculture.

Station: M. A. Scovell, director; H. E. Curtis, chemist.

Maine:

College: A. W. Harris, president; G. H. Hamlin, professor of civil engineering; Walter Flint, professor of mechanical engineering.

Station: C. D. Woods, director.

Maryland:

College: R. W. Silvester, president; W. T. L. Taliaferro, professor of agriculture; R. H. Alvey, jr., professor of English; H. Gwinner, professor of mechanical engineering; S. S. Buckley, professor of veterinary science; H. B. McDonnell, professor of chemistry.

Station: R. H. Miller, director; H. J. Patterson, vice-director and chemist; E. H. Brinkley, assistant agriculturist; W. G. Johnson, entomologist.

Massachusetts:

College: H. H. Goodell, president; G. E. Stone, professor of botany and mycology; L. Metcalf, professor of engineering and mathematics.

Station: J. B. Lindsey, chemist.

College (Institute of Technology): H. W. Tyler, C. F. Allen.

Michigan:

College: J. L. Snyder, president.

Station: C. D. Smith, director.

Minnesota:

College: Cyrus Northrop, president; W. M. Liggett, dean.

Station: Otto Lugger, entomologist.

Mississippi:

College: B. M. Walker, professor of mathematics.

Station: W. R. Perkins, assistant chemist.

Missouri:

College: R. H. Jesse, president.

Station: H. J. Waters, director.

Nebraska:

College: G. E. MacLean, chancellor.

Station: T. L. Lyon, agriculturist; F. W. Card, horticulturist.

Nevada:

College: J. E. Stubbs, president.

New Hampshire:

College: C. S. Murkland, president; Albert Kingsbury, professor of mechanical engineering.

Station: F. W. Rane, agriculturist and horticulturist.

New Jersey:

College: Austin Scott, president.

Station: E. B. Voorhees, director.

New Mexico:

College: C. T. Jordan, president.

Station: Arthur Goss, chemist.

New York:

Station (Ithaca): I. P. Roberts, director; G. C. Caldwell, chemist.

Station (Geneva): W. H. Jordan, director; F. C. Stewart, mycologist; F. A. Sirrine, entomologist.

North Carolina:

College: A. Q. Holladay, president; B. Irby, professor of agriculture.

Station: H. B. Battle, director; G. McCarthy, botanist and entomologist; B. W. Kilgore, assistant chemist.

North Dakota:

College: J. H. Worst, president.

Station: J. H. Shepperd, agriculturist.

Ohio:

College: Alexis Cope, trustee; T. F. Hunt, professor of agriculture; C. W. Burkett, assistant in agriculture.

Station: C. E. Thorne, director; S. H. Ellis, trustee; R. H. Holman.

Pennsylvania:

College: G. W. Atherton, president.

Station: H. P. Armsby, director.

Rhode Island:

College: John H. Washburn, president.

Station: Chas. O. Flagg, director; H. J. Wheeler, chemist.

South Carolina:

College: E. B. Craighead, president.

Station: M. B. Hardin, chemist.

South Dakota:

Station: J. H. Shepard, director.

Tennessee:

College: C. W. Dabney, jr., president; W. W. Carson, professor of civil engineering.

Texas:

Station: J. H. Connell, director.

Vermont:

College: M. H. Buckham, president.

Station: J. L. Hills, director.

Virginia:

College (Hampton): H. B. Frissell, principal; C. L. Goodrich, professor of agriculture.

College (Blacksburg): J. M. McBryde, president; L. S. Randolph, professor of mechanical engineering.

Station: W. B. Alwood, vice-director.

Washington:

Station: E. A. Bryan, director.

West Virginia:

College: J. L. Goodnight, president; W. S. Aldrich, professor of mechanical engineering.

Station: J. A. Myers, director; L. C. Corbett, horticulturist.

Wisconsin:

College: J. Q. Emery, regent.

Station: W. A. Henry, director; H. L. Russell, bacteriologist.

U. S. Dept. Agriculture:

C. W. Dabney, jr., Assistant Secretary.

Office of Experiment Stations: A. C. True, director; E. W. Allen, assistant director; W. H. Beal, W. H. Evans, C. F. Langworthy, L. P. Smith, F. H. Hall, G. A. Harlow.

Bureau of Animal Industry: D. E. Salmon, chief; H. E. Alvord, chief Dairy Division; E. A. de Schweinitz.

Division of Forestry: B. E. Fernow, chief; C. A. Keffer, assistant chief.

Division of Soils: Milton Whitney, chief; C. C. Moore, F. D. Gardner.

Road Inquiry: Roy Stone.

Division of Chemistry: W. D. Bigelow.

Department of the Interior:

Bureau of Education: W. T. Harris, Commissioner; Wellford Addis.

Treasury Department:

Geological Survey: F. H. Newell.

Canada:

Canada Experimental Farms: Frank T. Shutt.

Visitors:

David Siebert, J. W. Hoffman, John Hamilton, W. J. Quick, G. G. Groff.

PROCEEDINGS.

Morning Session, Tuesday, November 10, 1896.

The convention was called to order at 9 a. m. in the Grand Army Hall by the president of the Association, S. W. Johnson, director of the Connecticut State Experiment Station.

Prayer was offered by President R. H. Jesse, of the College of Agriculture and Mechanic Arts of the University of Missouri.

Mr. Goodell. For the executive committee I ask leave to read two paragraphs of the constitution relating to membership:

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the Association, with all privileges except the right to vote.

(4) In like manner any person engaged or directly interested in agriculture or mechanic arts who shall attend any convention of this Association may be admitted to similar privileges.

I am instructed to move that the chiefs of the several divisions and bureaus of the Department of Agriculture, and Bureau of Education of the Department of the Interior and representatives of State departments of agriculture be admitted to the floor of this convention with all privileges under this provision of the constitution, and that all visitors who have registered and come under the fourth provision of membership be also admitted to the floor of this convention during its proceedings.

Carried.

President Johnson. The report of the executive committee is now in order.

Report of the Executive Committee.

Immediately following adjournment of the convention of the Association held in Denver, 1895, a meeting of the executive committee was called and H. H. Goodell was elected chairman and J. H. Washburn secretary.

Very early in the year the committee was called upon to fill the vacancy caused by the temporary transference of Dr. Dabney to another position in a special committee appointed at the meeting of the Association held in Champaign, Ill., in support of a measure then pending in the Senate, entitled "A bill to regulate the number of officers in the Engineer Corps of the Navy." Henry C. White, of Georgia, was elected and has served on the committee ever since.

The numerous questions arising have involved a wide correspondence, and 383 letters have been written on Association matters. The following circulars have been issued from the office of the executive committee since the last convention:

(1) A circular letter embodying such extracts from the address of our late president, Henry E. Alvord, as set forth succinctly the objects and utility of the Association, and urging all colleges and stations not members of the Association to join at once and enter into active membership. What results have followed from this appeal the report of the treasurer will show.

(2) A circular of information, designating the new officers, with memoranda of business referred to the next convention.

(3) The resolution of the Association adopting a factor for expressing butter-fat records in approximate equivalent of butter.

(4) Preliminary notice of time and place of holding convention.

(5) The formal call for convention.

(6) A circular in support of the recommendation of the Secretary of Agriculture to create an office of director-in-chief of scientific bureaus in the Department of Agriculture.

(7) The general programme covering the three days of convention.

The year has been one of unusual activity, and the demands made upon the executive committee have been proportionally great. At one and the same time there were in Congress the following bills, nine in number, all touching the interests of this Association more or less vitally:

(1) A bill reorganizing the personnel of the Navy and permitting graduates of technical schools whose course of instruction had been considered satisfactory by the director-general of naval engineering, and approved by the Secretary of the Navy, to be appointed engineer cadets.

(2) A bill drawn on the lines of the so-called Hatch experiment station bill, establishing engineering experiment stations.

(3) A bill providing for the organization and maintenance of mining schools.

(4) A bill introduced by Senator Walthall to make an equitable adjustment of the grants of land to the several States of the Union for seminaries of learning.

(5) A bill introduced by Senator Tillman to equalize the several States of the Union in the grant of lands for school purposes.

(6) A clause in the appropriation bill providing for the organization of a division of land-grant colleges in the bureau of education, with a central office corresponding to that of experiment stations.

(7) A bill regulating the manner of purchase and distribution of seeds, bulbs, etc., by the Department of Agriculture.

(8) A bill of similar import placing upon the experiment stations the onus of testing and distributing seeds, etc.

(9) The recommendation of Secretary Morton to create an office of director-in-chief of scientific bureaus and investigations in the Department of Agriculture. And as if this was not enough, pursuant to instructions the executive committee made a last effort to bring about the completion of the records of the dairy tests made at the Columbian Exposition and to secure adequate compensation for fourth-class postmasters at experiment stations handling large amounts of franked matter of those stations.

What wonder if, amid these legislative rocks and whirlpools, our bark had foundered; or, endeavoring to steer clear of Scylla on the one hand, it had been suddenly swallowed up by Charybdis on the other. Gentlemen of the Association, unity alone can insure success, and we can not afford to be other than a unit when we come to the halls of Congress for aid.

Of these different measures, the one relating to the reorganization of the personnel of the Navy was most actively pushed during the entire session of Congress. A report of its progress and present condition will be made a little later by the chairman of the special committee appointed to advocate its provisions.

The bill establishing engineering experiment stations seemed in a fair way to be reported favorably when the unfortunate controversy arising in committee between two of its members awakened such antagonism that it was deemed unwise to ask for further consideration.

Neither one of the two bills equalizing the grants of land for purposes of instruction was reported for action. On Senator Walthall's measure several hearings were given and a favorable report secured from the Secretary of the Interior, but no further steps were taken.

A strong effort was made to secure the passage of an act organizing a division of land-grant colleges in the Bureau of Education. Each member of the subcommittee to whom the matter was referred was seen by one or more of your committee and the subject fully explained. "Retrenchment" had, however, been made the watchword of the Fifty-third Congress, and even so trifling a sum as that required for the equipment and maintenance of this office was refused.

The subject of adequate compensation to fourth-class postmasters handling large amounts of franked mail matter of the experiment stations has received due consideration, and a long correspondence has ensued with the Post-Office Department, confined mostly, on our part, to furnishing information. Definite action has not yet been taken.

The question of compiling, for permanent record, the dairy tests made at the Columbian Exposition was early called to the attention of your committee. A clause was introduced into the agricultural appropriation bill, permissive in character, allowing the completion of the work. It was favorably reported by the committee, but was ruled out on a point of order.

Briefly summing up the status of the nine measures submitted to Congress, four are still pending, three were stillborn in committee room, and two were lost.

It had been the intention to have the Lawes Trust represented at this convention, and Prof. Henry E. Armstrong, Ph. D., F. R. S., professor of chemistry in the London

Institution, had been designated as such representative. After due correspondence a place was assigned him on the general programme, but at the last moment, when too late to issue formal notice to members of the Association, a letter of regret was received from Sir John B. Lawes, stating that it would be impossible for Professor Armstrong to be present, and that there was not time to provide a substitute. It is probable that the report of the Rothamsted investigations will be made at the next convention.

In concluding this hasty review of the year's work, your committee desires to offer the following recommendations:

(1) That a committee be appointed to wait on the War Department and adjust relations between it and the colleges. A disposition has been shown to ignore expressed preferences in the detail of officers for college duty, and the Adjutant-General of the Army, in his late report, has recommended that details be made only to those institutions showing on their rolls the presence of 150 or more students.

(2) That the Association calls the attention of all concerned to the limitations of the franking privilege granted experiment stations. The law is explicit, providing only for the franking of bulletins and college reports containing the annual reports of stations. Great care should be observed by station officers not to abuse this valuable privilege so very necessary to the work of the stations.

(3) That the chairman of the section and the editors of the proceedings of the convention be constituted a committee to pass on the papers from each section, and that the Department be urged to print the papers recommended by this committee.

(4) That station directors drop from their mailing list the names of workers in other stations and depend entirely upon the list furnished at Washington, sending for a fresh copy at the time of issuing each bulletin. Changes among station workers are so frequent that the observance of this practice would result in a great economy of time and correspondence, besides securing greater accuracy. Why should directors send out notices of every change to 51 stations, and why should these 51 stations be compelled to make the necessary changes when it is done so much easier once for all at the Office of Experiment Stations?

(5) In view of the large and increasing number of measures which are introduced in Congress affecting the interests of the colleges and stations, and the frequent lack of cooperation among those interested concerning such measures whereby the influence of the Association and the interests it represents are liable to be materially weakened, the committee respectfully recommends that institutions, members of the Association, and their officers refrain from advocating measures affecting the interests of all until such measures shall have been considered and approved by the Association.

Respectfully submitted, for the executive committee.

HENRY H. GOODELL, *Chairman.*

WASHINGTON, D. C., *November 9, 1896.*

The report was accepted, with the proviso that the recommendations made be discussed and voted on separately at such time as the executive committee should appoint (see p. 30).

Mr. GOODELL. We have just received news that General Hatch is lying in a very critical condition and probably will not recover. It seems fitting that while we are here we should send him some message from the Association, and I therefore move that the secretary of this convention send him a telegram expressing our sympathy.

Carried.

Mr. Atherton moved that a committee be appointed to prepare and send proper resolutions of regret to the family of Hon. Edwin Willits.

Carried.

The CHAIRMAN. The next business in order will be the report of the Section on Agriculture and Chemistry, by C. C. Georgeson, of Kansas.

REPORT OF THE SECTION ON AGRICULTURE AND CHEMISTRY.

It will be impossible for me in the brief time allotted to do justice to the workers by detailing all the work that they have had in hand during the past year. Much of it, indeed most of it, must necessarily be passed by without any mention whatever, not because the work does not merit it, but for sheer lack of time.

I sent a circular letter of inquiry to all the colleges and stations reported in the organization lists published by the United States Department of Agriculture, and addressed it to those men in each institution whom I deemed most likely to be able to give the information I required as heads of their respective departments. I divided my questions into four classes—those bearing on college work in agriculture,

on college work in agricultural chemistry, on experiment work in agriculture, and on experiment work in chemistry. Since the college work will be treated more fully in another section, I shall here merely give a few statistics in regard to instruction in the two lines mentioned.

Instructors and students in agriculture and agricultural chemistry.—Thirty-five institutions reported 117 instructors in agriculture, 48 of whom are assistants, and 36 institutions reported a total of 17,413 students. Of this number 2,963 were in agricultural courses during the past year. Of this 2,963 students 1,355 were in the long or regular courses of their respective institutions, 237 in a two years' course, 1,258 in short courses, and 113 were post-graduate students in agriculture.

Of the institutions addressed in regard to information on the subject of chemistry, only 36 replied, and only 32 of them gave information as to the teaching force. In these 32 institutions there were 61 instructors in agricultural chemistry, 23 of whom were assistants. Only 25 out of the 32 had any students in agricultural chemistry the past year, but in these 25 institutions 925 students received instruction in agricultural chemistry. This number includes only those who actually took lectures, and does not include students who were in the agricultural courses and who would eventually get this line of study. That is to say, 63 per cent of the institutions which have agricultural courses in their curricula gave instruction in agriculture and agricultural chemistry in their restricted sense to 3,888 students during the past year. Though possibly a few hundred are counted twice, these figures will aid in giving us an idea of the work that has been done in the line of agricultural instruction.

Additions to facilities of instruction in agriculture and agricultural chemistry.—Thirty of the institutions from which I received reports have made permanent additions to their equipment for instruction in agriculture and agricultural chemistry during the past year to the total value of $202,724. This includes, however, the veterinary building at Cornell, valued at $150,000. If we deduct this very large item it still leaves $52,724 which has been expended on the erection and improvement or equipment of laboratories, dairy buildings, barns, and outbuildings or in the purchase of live stock, machinery, apparatus, models, and specimens. It is not an excessive outlay, and yet, for about 52 per cent of the institutions, $52,000 annually will doubtless go a good way toward improving facilities for instruction in these two lines of work.

Subjects taught.—All of the institutions reporting teach all the leading lines of agriculture, but in some cases special emphasis is laid on one or more lines of instruction. Thus, in California fiber culture and forage plants and fruit especially adapted to the coast are given special attention. In the South general field crops and improvements of soils are emphasized more or less, and dairying is given special attention in the following States: Colorado, Connecticut (Storrs), Georgia, Idaho, Iowa, Kentucky, Michigan, Minnesota, Mississippi, Oregon, South Dakota, Texas, Vermont, Virginia, West Virginia, and Wisconsin.

Work of experiment stations.—Thirty-eight experiment stations which reported work in agriculture employ 153 workers in this one branch, 89 of whom are superintendents or directors and 64 assistants, and 100 of them have college duties to perform in connection with their work in the experiment station. In the line of agricultural chemistry 38 institutions employ 107 workers, 47 of whom are superintendents or chiefs, and 60 assistants, and 47 of them have college work in connection with the station work.

Lines of investigation.—Cultural experiments with field crops demand much of the attention and energy of the experiment stations. Common field crops, corn, wheat, oats, and to some extent barley and rye, and in the South cotton are experimented with in nearly all the stations. There are a few that do not lay much stress on this work, as, for instance, Vermont and California, but these are exceptions. The experiments are for the most part planned to meet the demands of the respective regions in which they work. The lines of experiments with field crops are very numerous, and I can only mention the leading ones here. First, variety tests with the average field crops to ascertain which varieties are most suitable for a given locality; second, rotation experiments, which have been in progress the past year and in most cases for several years in Alabama, Colorado, Indiana, Kansas, Maine, Michigan, Minnesota, Missouri, New Jersey, Pennsylvania, Rhode Island, and probably in other States.

Preparation of the soil has also been a leading feature of the experiments with field crops, as well as various cultural methods, quantity of seed, depth of plowing, etc. These experiments are beginning to bear valuable fruit. Many of the stations have results on the same lines of work for half a dozen years or more, and can now state with tolerable certainty what methods will be the most profitable for the farmers to follow under particular conditions. Subsoiling experiments are reported from Oklahoma, Wyoming, and Kansas. Doubtless this practice is tested at many other stations. It is of special interest in the States and Territories where the rainfall is insufficient.

The nonsaccharine sorghums, and especially the varieties of Kafir corn, have been

experimented with at several Western stations with gratifying success, especially in Oklahoma and Kansas. Cultural methods for tobacco are reported from Alabama, California, and New York (Cornell).

Cross fertilization to develop new varieties of grain crops is reported from Minnesota and Mississippi.

Cañaigre has been grown in California and Alabama.

Sugar beets have been grown in Nevada, Nebraska, and New Mexico.

Experiments in the irrigation of field crops are reported from Wyoming, New Jersey, Alabama, Minnesota, and Mississippi.

In the effort to find forage plants well adapted to particular regions a number of stations report variety tests with grasses and forage plants of all kinds. In this connection it should be mentioned that Connecticut and California are among those making special effort to introduce new species of grasses and forage plants. In California the object is to find something that will thrive in alkali soils and semiarid regions, and in Connecticut some 1,500 species and varieties from all parts of the world are grown in experiment plats. Legumes receive special attention in Idaho, Iowa, Kansas, Wyoming, Michigan, New Hampshire, New Jersey, New Mexico, Pennsylvania, and Rhode Island, the promising forage plant known as soja bean being tested in Iowa, Kansas, New Hampshire, and New Jersey, and *Lathyrus sylvestris* in Kansas and Michigan. The culture of silage crops received special attention in Connecticut, nurse crops for grass in North Dakota, and fertilizer tests for forage plants in Connecticut and Maine. Experiments with root crops for forage are reported from Idaho and Iowa.

Extensive feeding experiments have been carried on at a large number of stations, in some cases by the agriculturists alone and in other cases in cooperation with the chemists. The feeding of steers is reported from Colorado, Iowa, Kansas, Maine, Michigan, Minnesota, Mississippi, Pennsylvania, Texas, and Wyoming. The feeding of sheep has been experimented with in Colorado, Indiana, Iowa, Minnesota, Washington, and Wyoming. The feeding of dairy cows has received special attention in Alabama, Colorado, Maine, Michigan, Minnesota, Mississippi, New York (Cornell), Pennsylvania, and Washington. Pig-feeding experiments have been made at a large number of stations. Experiments in feeding horses have been carried on in North Dakota, and with poultry in New York (Cornell), West Virginia, and Rhode Island.

Digestion experiments have been under way in Connecticut, Maine, North Carolina, Oregon, and Wyoming.

Dairy work, as already indicated, occupies a prominent place in many experiment stations. The leading features of this work may be classified as follows: Tests of dairy machinery and apparatus in Colorado, Pennsylvania, Vermont, and Wisconsin; milk testing in Connecticut, Idaho, Kansas, New York (State), North Carolina, Ohio, Oregon, Vermont, and Wisconsin; pasteurization of cream and milk in Illinois, Michigan, New Hampshire, Vermont, and Wisconsin; the use of pure cultures in Connecticut (Storrs) and Wisconsin; general dairy bacteriology in Wisconsin and New Jersey; experiments in cheese making in Minnesota, Pennsylvania, and Wisconsin; and important work with tuberculosis in connection with dairy cows in Michigan, New Jersey, and Wisconsin.

Lines of investigation of a chemical nature are very numerous. They deal with every subject in relation to soil and plant food, the examination of food stuffs and manures of all kinds, and with products of the farm of every description. Soil analyses, both physical and chemical, are reported from 13 stations. Some points of much importance are under investigation. In the semiarid region of California and other States the problem of how to eliminate injurious alkali has received much attention. In Rhode Island the acidity of the soil has been a subject of special investigation. Irrigation waters have been analyzed in all the States where irrigation is practiced, and potable waters in many other States. The analysis of dairy products has received special attention in California, Delaware, Maine, Massachusetts (Hatch), Michigan, Missouri, Nevada, New Jersey, New York (State), Ohio, and Oregon. Fifteen stations have reported work on feeding stuffs of many kinds. The composition of wheat and flour has been given special attention in Michigan, and analyses have also been reported from Arkansas and North Dakota. The properties of cañaigre have been investigated in Arizona and Texas. Sugar beets have commanded a large share of the attention of chemists in 9 stations, chiefly in the Mississippi Valley and in Oregon and California. The amount of moisture in the soil under various conditions and at various depths has been investigated in Iowa, Kansas, Minnesota, Mississippi, Nebraska, New Jersey, New York (Cornell), and Wyoming. Artificial digestion experiments are reported from Colorado and Connecticut (Storrs). The availability of organic nitrogen has been studied in California and Connecticut (State), and the starch of both sweet and white potatoes in Georgia and South Carolina. Analyses of fruits have been made in Idaho and New York (Cornell). The influence of the food on butter fat has been under investigation in Pennsylvania.

Tobacco analyses have been made in Connecticut, Pennsylvania, and Wyoming. Methods of analysis of various substances have received the attention of chemists in Indiana, Massachusetts (Hatch), and New Hampshire. The composition of farm crops has been investigated in Connecticut (Storrs) and Oklahoma. The calculation of the value of fodders by the method of least squares is reported as having been under investigation in Vermont. Lastly, the chemists at a number of stations have been burdened with the analysis of commercial fertilizers, the State laws in many States requiring that the station shall analyze samples sent them, and in several of them the station exercises control over the fertilizer trade. From the amount of work that has been published, as well as the number of stations which have reported work in this line, I judge there is no one line of chemical investigation that demands so much of the time and energies of the agricultural chemists of this country as the analysis of fertilizers.

Soil physics has received a great deal of attention in many States, particularly in relation to soil moisture, this being a question of paramount importance, especially in the arid and semiarid regions. Wisconsin has done notable work in this line, and also Dr. Whitney, of the United States Department of Agriculture.

Miscellaneous investigations of interest have been in progress in several States, as, for instance, an experiment in crossing the Persian fat-tailed sheep on Merinos and Southdowns in California, the bacteriology of tobacco in Connecticut, and the development of roots in various field crops in Kansas.

Publications.—I regret to say that I have not a complete list of the publications issued by the stations during the past year, so the number I give here will fall considerably below the actual number issued. The chemists of 28 institutions report a total of 71 bulletins, covering 2,032 printed pages, and the agriculturists of 29 stations report 76 bulletins in their particular lines, covering 3,543 printed pages. This makes a total of 147 bulletins, covering 6,754 printed pages, from the workers in this section during the past year; but, as less than three-fourths of the stations gave returns on this point, it would probably be more correct to estimate the total output of publications during the past year at 225, with 9,000 printed pages. What this means as to the dissemination among the people may perhaps best be realized when I state that in Wisconsin alone the actual number of printed pages amounted to 32,824,000.

C. C. GEORGESON, *Chairman.*

The report was accepted.

The CHAIRMAN. The next report in order will be that of the Section on College Work.

In the absence of the chairman, A. A. Johnson, of Wyoming, the report of the section was submitted by the vice-chairman, J. E. Stubbs, of Nevada.

REPORT OF THE SECTION ON COLLEGE WORK.

Owing to the quite recent resignation of the chairman of the Section on College Work, I have been called upon, as vice-chairman, to perform his duties. Whatever of completeness and thoroughness may be lacking in this paper is due to the very limited time allotted to its preparation.

I invite your attention at first to a somewhat common incident. Imagine yourselves for the moment in the library car of the Union Pacific express, east-bound, on the evening of the 4th of November. For the most part, the occupants of the car are Western men of affairs, keen and practical. Conversation and discussion over the exciting news of election day have begun to grow weary, when suddenly new interest is aroused by the introduction of a fresh topic, namely, the kind of an education which should be given to farmers' sons. Two bright-minded men, one from Montana and the other from Colorado, affirm that there is too much of higher-education nonsense in the country; that one of the modern heresies is that of giving the so-called higher education to farmers and farmers' sons, who would do better for themselves and their country if they were content with a common-school education along with the practical discipline and training of the farm. This opinion is hailed with a chorus of approval, with the further observation that there is too much of football and of similar sports in the college education of to-day. The first protest against the views just set forth came from a young lawyer, I believe, of Wyoming, who charmed us by a prophetic vision of the possible Websters and Clays and Jacksons that might be lost to our country if the farmer boy should fail to realize his ambitious dreams of public life because of the repressive influences which restrict his education to the district school and his scientific training to the field and the stable.

This incident is worth noting, for the reason that it expresses the views and convictions of very many men who are thoroughly practical, able, and successful in their own respective callings.

Being an interested listener to the discussion, I tried to formulate in my mind three propositions which, by way of answer, I should be willing to maintain:

First. That the higher education, so called, has become absolutely essential to the prosperity and welfare of those who choose agriculture as a business or a life calling. This holds true, also, with respect to industrial callings, such as engineering in its various branches and the higher class of commercial activities. If it be true that "the test of national welfare is the intelligence and prosperity of the farmer," then the colleges of agriculture and mechanic arts established by the Federal Government have been wisely established, and will cement more firmly the foundation of the national prosperity and honor. Our practical-minded friends of the discussion have simply failed, like many others, to give due weight to the remarkable changes which have taken place in the industrial training and education of youth. The technical schools and the schools of applied science in colleges and universities have taken the place of the shop and the foundry of our fathers' time, and partly, too, of the farm, in the industrial education of this country and of other countries as well. These "institutions for higher education," these "colleges of agriculture and mechanic arts," now stand at the end of the Appian Way, to eager feet the noblest gateway to the Eternal City of industrial and commercial prosperity as well as to political peace and supremacy.

On the other hand, the lawyer from Wyoming has failed to grasp the truth that there are other lines of education than the accepted type of classical education which, while giving wide range of choice to special taste and aptitude, is both broad and liberalizing, and gives development and culture to the man, while training him in the particular disciplines which fit him for the successful pursuit of industrial and commercial callings.

If, according to Dr. W. T. Harris, United States Commissioner of Education, "urban life is the life of the future, and of the highest civilization," one or the other of two effects must follow in the future life and growth of this country. Either our soil will be tilled by tenants for the benefit of the landowner who resides in town or city, giving thereby encouragement to the growth of two distinct classes—the one a poor, dependent peasantry; the other an intelligent but selfish and unpatriotic class of absentee landlords—or we must cherish and develop in our schools and colleges that kind of training and culture which shall build up an intelligent, prosperous and independent class of farmers and artisans, each of whom owns his home, tills his own fields, markets his own products, helps to regulate the affairs of his own township, sits in the councils of his own State or of the nation, in character, in intellectual and in social qualities the peer of lawyer, capitalist, or priest.

Second. That the interest in athletic field sports, such as football, baseball, and tennis in our colleges, though but incidental to the life and work of these institutions, has nevertheless an ethical, and thereby educational value, which is worthy of high regard. The college president who keeps in view the highest character development of his students knows full well that the athletic exercises which have become, and which will remain, a striking feature of college life do, when properly guided and guarded, displace to a considerable degree the pernicious practices that spring into action when any body of young people are brought together in common association, and do further promote the cultivation and attainment of the better qualities of personal character such, for example, as courage, obedience, endurance, and regard for personal honor. The gymnasium of Germany and the public school of England offer a strong contrast in this matter of school and college field sports, but the free and vigorous activity of Eton's football or cricket field is superior from every point of view to the rigid and systematic ordering of the daily exercise of the German gymnasium boy and to the dueling practice and drinking habits of the university student. The truth is that the outdoor life and the field sports, which have grown so rapidly into favor with American colleges, not only with the colleges for young men, but also with those for young women, may be so guided as to promote a high average of scholarship, good habits, perfect health, yea, a graceful type of womanhood as well as a sturdy type of manhood.

Third. That in the correlation of the subjects of instruction and discipline according to accepted pedagogic principles in the courses of study offered by the colleges of agriculture and mechanic arts, it will be found that the particular subjects in mathematics and in pure and applied science are carefully harmonized with those general subjects in language and literature, in the social sciences, and in history and philosophy, which pertain to the college courses usually denominated *liberal*.

As bearing upon this point, I quote the views of Prof. E. W. Hilgard, of the University of California, as given to me very recently in a personal letter. He speaks of the course in agriculture given by the University of California as follows: "With the average preparation we can command in this State we find it necessary to devote the first two years of four substantially to the preparatory sciences and general culture studies, while the last two are given to the technical studies chiefly, though not exclusively. Among these elections should always be allowed, enabling the

student to put special weight upon those branches that will be of chief importance to him in after life. We do not as yet in this country aim to educate all-round agricultural experts; there is too little demand for them, and when the demand arises the degree and kind of preparation is likely to have been changed by the introduction of agriculture science into the preparatory school. Then only will it be possible to establish a uniform course for the degree of bachelor of agriculture that will hold good all around. It makes a wide difference, too, whether the student comes from the farm or from the city. The latter clearly requires a different course, especially as regards practical studies, from the boy who has grown up on the farm and merely needs to give the explanation, as it were, of the practices he is already familiar with. An all-round agricultural expert can not, with our usual preparation, be turned out in four years. Agricultural science is the most complex of all, embracing as it does all the sciences from mathematics through physics, chemistry (both inorganic and organic), mineralogy and geology, botany, zoology (both theoretical and technical), vegetable and animal physiology, plus a certain amount of engineering. Unless a man specializes, the field is too wide to be covered in four years with any degree of thoroughness. For the present, then, we must leave the way open to specialization after a certain amount of general training, the time for which varies constantly with the conditions of the public and the preparatory schools."

Again, touching further upon the preparation and character of technical work in the course of agriculture leading to the degree of bachelor of science, Prof. Thomas F. Hunt, dean of the college of agriculture of the Ohio State University, writes to me as follows:

"In a general way I would say that the four years' course in agriculture leading to the degree of bachelor of science should consist of one-third technical work of applied science, one-third science, and one-third language, history, and philosophical studies. It is, of course, difficult to classify studies precisely into the three groups mentioned, but in a general way I think we all understand it. On this basis, our course at the Ohio State University, requiring 206 hours for graduation, contains the following technical work: Agriculture, 36 hours; agricultural chemistry, 20 hours; horticulture, 8 hours; veterinary medicine, 15 hours; economic entomology, 5 hours—a total of 84 hours. Of the 206 hours, it is to be noticed further that 30 hours are elective, and that these may or may not be technical. But disregarding the number of elective hours, we require 84 hours which may be fairly termed technical. This gives rather more than one-third technical work, and perhaps this is a little heavy."

It is to be observed that the 206 hours at the Ohio State University represents a fraction more than 17 hours a week for twelve terms. The proportion of technical work in the course outlined by Professor Hunt, even if we credit the 30 hours of election to technical subjects, and thus establish a course which represents the maximum number of hours to technical discipline, allows ample room for such cultural and social studies as will stamp the course with the character of giving a liberal education to its students. It may be observed further that the acquaintance with the general truths of science which these technical subjects give will be of great service in the rational interpretation of all social phenomena, and we may therefore credit the technical studies with a definite value in respect to the kind of knowledge "which is of most worth."

ENTRANCE REQUIREMENTS.

One of the most important subjects at present engaging the attention of the Association is that which pertains to the requirements in branches of study that shall be established for admission to the freshman class of the colleges of agriculture and mechanic arts, the extent and variety of the courses of study to be offered, and the academic degrees which shall be bestowed.

The deep and widespread interest in this subject is in evidence by the appointment, two years since, of a committee from this Association, by the "report of the committee of ten" on secondary school studies and the "report of the committee of fifteen" on elementary education, both to its National Educational Association, and also the report on the subjects of entrance requirements by the Society for the Promotion of Engineering Education; further, the appointment of a standing committee of five members from this Association whose duty it shall be to report annually upon the best methods used in the various colleges and universities in the United States and in Europe for the instruction of students in the practical and scientific facts relating to agriculture, with the view to bringing instruction in agriculture into pedagogic form, gives additional emphasis to the importance of the matter of entrance requirements, and also the earnest purpose of the promoters of scientific and industrial education to put their subjects and methods into scientific form and relations.

I submit herewith the results of a brief study of the facts as they bear upon the present standard of requirement for admission to the freshman class of the colleges

and universities that have membership in this Association. The questions which I submitted to the colleges, bearing upon the questions of entrance requirements, were intended to be specific and easily answered. I have received no replies to my letters from Utah and North Carolina.

Out of 46 colleges reporting, 30 have preparatory departments, 16 have no subfreshman classes. In these preparatory schools 10 colleges have a one-year course, 8 have a two-years' course, 6 have a three-years' course, 1 has a four-years' course, and 5 are indefinite, merely reporting a subfreshman class.

SPECIFIC SUBJECTS.

English.—Eighteen colleges have the standard high school requirements in English language and literature for admission to the freshman year. Twenty-eight colleges require that which represents the work accomplished in the eighth or ninth grade of the public schools.

Arithmetic.—Thirty-eight colleges require this subject to be completed. Eight colleges require the subject as far as interest and proportion.

Algebra.—Thirty-four colleges require algebra to or through quadratic equations. Four require the academic algebra to be finished. Eight do not ask for algebra.

Geometry.—Five colleges ask all of plane and solid geometry. Eleven colleges require all of plane geometry. Four colleges require from two to four books of plane geometry. Twenty-six colleges do not place geometry upon the list of subjects for admission to the freshman year.

United States history.—All the colleges make history of the United States an entrance requirement. Thirteen colleges require also general history.

Physics.—Fifteen colleges require elementary physics with laboratory practice.

Chemistry.—Nine colleges require elementary chemistry with laboratory work.

Physiology.—Seventeen colleges require elementary physiology.

Botany.—Eight colleges require elementary botany with field practice.

French or German.—Eight colleges require a reading knowledge of French or German.

Latin.—Twenty colleges offer from one to three years of Latin in their preparatory schools and several offer Greek.

The institutions which have no preparatory departments are chiefly the universities in the wealthy and populous States where there are first-class high schools in all the cities and towns. In the newer and less populous States a well equipped preparatory school of high-school grade with courses of studies covering a period of three or four years is a necessity, and will continue to be a necessity for very many years to come. The preparatory department is the means of supply to the college of many students who otherwise would never think of taking a college course.

It is evident, too, that the agricultural colleges divide themselves into two classes. The one class receives the student into its freshman class from the eighth or ninth grade of the public school. The course in agriculture, then, becomes in the main a technical high-school course of study, with special reference to the farm and the farmer.

The other class of agricultural colleges requires the completion of a high-school course of study as a requisite for admission to its freshman class, and then seeks to maintain strong four-year courses in agriculture, and in the applied science courses, such as engineering, civil, electrical, mechanical, and mining. In those States where the State university maintains strong schools of applied science, and where the agricultural college is an entirely separate institution from the State university, it is evident that the college of agriculture and mechanic arts has found its field of work to be limited to giving a thoroughly practical training adapted to young men and young women who have finished such courses as are laid down in our best ungraded schools and best grammar schools.

The weight of opinion in this Association seems to be that the colleges endowed by the Federal Government under the acts of 1862 and 1890 should be colleges according to the accepted standard in the best educational circles. I quote a paragraph from President Alvord's address given at Denver last year, viz: "Institutions in affiliation with this Association should in all respects be colleges in fact as well as in name."

NUMBER OF COURSES OFFERED.

In reply to the question, "How many four-year courses do you maintain?" I note the following: Ohio State University offers 15 courses; University of Washington, 14; Pennsylvania State College, 12; Maine State College, 9; California, Purdue, Kentucky State, Minnesota, Cornell, Virginia, and Wyoming, 7; Delaware, Idaho, Tennessee, and Wisconsin, 6; five colleges give 5 courses; eight colleges give 4; three colleges give 3, and fourteen colleges give 1 and 2 courses with numerous electives.

This general outline of the number of courses shows that the colleges of this Association, even the weakest of them, are able to give a breadth and variety to their college work which is enjoyed only by the students of the oldest and best known universities of this land.

The distinguishing feature of most all these courses of study is that they belong to the department of applied science; this is what differentiates them most strikingly from the average college of liberal arts. This it is that characterizes these colleges as the great schools for the industrial life of this country. This gives to us the great opportunity for training young men and women of high character and lofty ideals to become examples as well as leaders in the world's commercial and industrial activities.

All the colleges give courses in agriculture. Twenty-five have courses in civil engineering; twenty-two in mechanical engineering; twelve in electrical engineering, and five in mining engineering. Many of the mining States have a school of mines entirely separate from any other institution, or in connection with the State university.

FEW STUDENTS IN AGRICULTURE.

But why so few students in the advanced agricultural courses? I think the answer is found in the conditions of agriculture at the present time; other departments of labor are more remunerative than that of farming. In many of the States there is not a ready market for agricultural products. In some States, at least, if not in all, the farmers themselves are not awake to the value of training in the agricultural college. In August last, eighty-five boys, *farmers' boys*, entered the University of California, but not one entered the course in agriculture. The six students who did enter the course of agriculture were from the cities. Yet it is wholesome to the thought and life of all our industries that agriculture be elevated to a worthy place in our system of college education. The comparatively few students who may complete these courses are worth to the country all their training costs, and when the time comes for the adjustment of the present unequal distribution of rewards of labor, the college-trained, scientific farmer will be in patriotic demand.

All the colleges save eight are making special efforts to attract students to courses in agriculture. Addresses before farmers' institutes, lectures upon scientific topics, newspapers, bulletins, and contributions to newspapers, are the principal means of bringing the work of the college to the notice and the esteem of the public.

MILITARY INSTRUCTION.

The department of military instruction in the colleges of this Association is a subject I can not leave unnoticed. The military authorities have given particular attention to this subject from their point of view within the past two years. The Adjutant-General of the Army, in his report for 1896 to the Secretary of War, says: "The average number of students at the several institutions during the scholastic year was 3,401 less than during the preceding one, due perhaps to prevailing monetary depression. The number of those capable of military duty was, however, 3,009 more, and the number required to be enrolled as military students has increased 2,761. The aptitude and interest of these students under military instruction is generally satisfactory." The Adjutant-General further says: "The law authorizing details should be amended. I recommend that hereafter no detail be made to any institution that can not guarantee an enrollment of at least 150 military students, and that military professors at institutions having a less number in their military department be withdrawn and returned to their regiments."

If the recommendation of the Adjutant-General should become a law the agricultural colleges of the following States would lose the detail of the military professor, according to the report of last year under the head "Required enrolled as military students," viz: Colorado, Delaware, Florida, Georgia, Idaho, Louisiana, Maryland, Massachusetts, Nevada, New Hampshire, New Jersey, North Dakota, South Dakota, Oregon, Rhode Island, Tennessee, Utah, West Virginia, Washington, Wyoming—twenty colleges in all. Now, I venture to affirm that to strike these twenty States from the benefit of the military instruction provided for under the Morrill Act would lose to the service much of the very best work that is done outside of West Point and the purely military schools. Take an illustration: I find that one of the leading Ohio colleges reports 997 students as capable of military duty. Of these, 119 received military instruction and 77 were uniformed. It is evident from the above figures that the military spirit and military training does not abound in that institution. Furthermore, every college man knows that in the larger institutions of the East and middle West it is difficult to develop and maintain good military spirit and discipline. Now, compare this example with the Nevada State University that last year had at one time nearly 142 in the cadet battalion; that had an average attendance of 114 cadets, every one in uniform; every one required to perform his military

duties regularly and strictly under the instruction of the commandant; theoretical instruction in the art and science of war given as a college requirement once a week to the cadets of the junior and senior classes of the University; one hour to drill every college day in the week, save one, throughout the year, and the military department in favor with students and faculty. Now, what is true of the Nevada State University is true, I believe, of nearly all the colleges established under the Morrill Act. The number of cadets in the Military Academy at West Point last year was 331. The recommendation of the Adjutant-General would put the minimum number of students in one of the colleges of this Association to get the detail of an army officer at 150, but 15 less than the half of the total number at the United States Military Academy last year.

Again, in a recent article by Maj. Joseph E. Sanger, it is intimated that there is a decline in interest on the part of the officers of the colleges in the military department; that the instruction is not always up to the standard, and that in some faculties there is to be found positive opposition to the military department. I must say that I do not think these criticisms apply justly to many of the colleges; they ought not to apply to any. The provision for military instructions in the Morrill Act is a good provision, and should be welcomed by the administration of every college that enjoys the benefit of that act. "Whatever is worth doing at all is worth doing well" applies right here.

It will be very easy, moreover, to remove any occasion for the above criticism. To avoid any possible misunderstanding that the college faculty is not favorable to the department of military work, it should be understood that the military department is responsible through its commandant directly to the president of the college or university, and through him to the board of regents and trustees.

Again, the instruction in military science and tactics should be placed on the same footing with other subjects of instruction, and satisfactory work be required from every student who is a candidate for a degree.

A word may be said in respect to the kind of officer that should be detailed to college work. Not every officer is fitted by nature and training to become a successful college instructor. No officer who seeks an easy berth should be detailed to the college; but one who likes to work with young men, who is possessed of scholarly tastes and habits, who has a lofty ideal of the true soldier's character and life, and who, in cooperation with the president and faculty, will infuse a worthy military spirit into the young men and aid in the development of a type of strong, self-reliant, loyal manhood, which this country will ever need.

The union of military training with the development of the civic spirit in the education of our young men will dower this nation with a reserve corps of citizen-soldiers unsurpassed in excellence by any age or in any land.

J. E. STUBBS, *Vice-Chairman.*

The CHAIRMAN. If there be no objection, the report just read will be accepted.

The CHAIRMAN. I take this occasion to announce the committee appointed to draft suitable resolutions on the death of Hon. Edwin Willits: G. W. Atherton, of Pennsylvania; C. D. Smith, of Michigan, and A. Q. Holladay, of North Carolina.

The CHAIRMAN. The next business in order will be the report of the Section on Horticulture and Botany, by F. W. Card, of Nebraska.

REPORT OF THE SECTION ON HORTICULTURE AND BOTANY.

In making up a report of the work of horticulture and botany it seemed advisable, in so far as possible, to get at the policy and aims of the different institutions and workers rather than to make a definite report of the actual work done during the preceding year. Most of our experimental work is still young, and much of our teaching, particularly in the line of horticulture, crude. We have no well-beaten track to guide us, and many of us are comparatively untried. We are largely groping in the dark for something which we feel must be there, but which too often eludes our grasp, while we are at the same time trying to make the way clear and plain to the students intrusted to our guidance. Here and there one finds a path to some hidden treasure, but for the most part it remains known only to himself, and only his students get the benefit. Let it be understood that I am here speaking of horticulture. Botany is older, has long been in the educational curriculum, and has its lines of thought and teaching well mapped out. Not so with horticulture; its pedagogical structure is yet for the most part to be builded. Its literature is scattered to the four winds of the earth, and no one man can hope to gather it together. No one is likely to attain so great knowledge of the subject that he need fear to disclose it, and each needs the help of all the others. Shall we not work together for the upbuilding of the subject as a whole rather than for its upbuilding at our own institutions?

Does horticulture follow botany?—In order to get at methods and aims, circular letters were sent to all the horticulturists and botanists, with a somewhat long list of inquiries. In this circular the first question asked was, "Does horticulture, as taught in your institution, follow botany, using the latter as a foundation?" Upon this point there seems to be comparative uniformity. Nearly all reply that it does, a few say that it is not necessarily so, while one says that botany is given at the same time, but is in no sense preparatory to horticulture any more than is Latin.

Doubtless most of us feel that botanical work is a very important aid to horticultural work, and much prefer, even though we may not insist upon it, that our students should have had some botany before taking up horticulture. If so, the outlook is encouraging.

Landscape gardening, forestry, and floriculture.—The next question asked was whether landscape gardening, forestry, and floriculture are taught, and if so, by which department. The replies indicate that, of the number of institutions from which answers were received, landscape gardening is taught by the horticultural department in 25, by the two combined in 2, while in 9 it is not taught. Forestry is taught by the horticultural department in 16, by the botanical department in 6, and by the two combined in 1, while 11 report that it is not taught. Floriculture is reported taught by the horticultural department in 22 institutions, by the two combined in 2, while it is not taught in 11.

Here are three distinct lines of work, each of which is worthy the undivided attention of anyone, which are being carried by the men who are upholding the banner of horticulture and botany. I need not say that they are not carried as they should be, for that goes without saying. Yet I would that these things might be more fully appreciated in order that the reason for some of our shortcomings might be better understood.

Experimental plant physiology.—More than half of the institutions heard from report that little or no instruction is given in experimental plant physiology. Of course, in many of these there is some incidental class-room mention of it, but no course is offered in which the student makes it his especial aim to get at the functions of plants by means of experiments carried out by himself. All unite in saying that some previous preparation in botany is needed in order that such work shall be profitable. Some say one year, others say at least two years, while more say that it is taken by juniors in their course.

In the majority of cases where given, it is stated that all regular agricultural students take it. In some cases, however, it is given without any reference to the needs of students in horticulture. One botanist states that his laboratory is well equipped for this work, that he makes a great deal of the subject, and that it is taken by all botanical students who elect to work. But he says that horticultural students do not get it, that horticulture is taught as a business, not as a science. Ought this thing so to be? The student goes to college not to learn business, though in such practical subjects much of this very properly enters. He goes rather to search into the deeper principles underlying the questions and problems with which he deals. If any person on the face of the earth needs to know something of the way in which plants carry on their functions, it is the horticulturist, a fact which many of us have had abundant cause to see, and the want of which to regret. Is not this one of the subjects which should be pushed to the front and which should be so arranged that all students who expect to deal with living plants shall get as much light as possible along this line? Experience must show how much and what ought to precede it and what problems most need elucidating.

Economic botany.—Twenty institutions report courses in botany which have a distinctly economic bearing from an agricultural standpoint. Of these, courses on economic plants and on parasitic fungi head the list. One reports a course in ecology and one a course on commercial products. It is not to be inferred that those who do not report such special courses neglect the economic side of the subject, for most of them say that it receives attention in connection with the other work, by way of illustration or otherwise. One well-known professor reports that nearly all their botany is economic and agricultural. It is merely a question of method, since all recognize the need, and the method each man can best solve for himself.

Horticultural instruction offered.—To in any way summarize the courses of instruction offered in horticulture at the different institutions is a difficult matter. Fruit growing and vegetable gardening naturally form the basis of such instruction everywhere. Only two of the institutions answering fail to report both of these or to leave it implied by a general answer that they are taught. Ornamental or landscape gardening ranks next in the number of institutions at which it receives attention, followed by floriculture and forestry in turn. Nine professors report a course in plant breeding, or the variation and evolution of plants under culture. Six make special mention of greenhouse construction and management, five of propagation of plants, three of crossing, and three of plant diseases. Only three report courses in library work. Spraying, viticulture, and seed growing each receive special mention

twice, while nomenclature and a course in the botany of cultivated plants are each mentioned once. Original investigation also receives but slight mention, probably owing to the little demand for it. Among these minor subjects, propagation, crossing, plant diseases, spraying, viticulture, and seed growing undoubtedly receive attention more or less fully in connection with other work at most institutions. Probably only under special conditions are separate courses needed for any of these, unless it be in the matter of propagation.

One point in this summary may be worthy of special attention, and that is the slight mention of library courses. To be sure, this report does not measure the use made of libraries, and, indeed, several mention the auxiliary in connection with the laboratory or practical work. It does seem to indicate, however, that the value of the library is not fully appreciated. In my own experience no work has proved more satisfactory for students who have sufficient foundation to work understandingly than seminary courses. With some advice in the matter of taking and arranging notes and references, so that they shall be quickly available ever afterwards, the student soon appreciates the fact that he is getting something of permanent utility and value. To my own mind the card or slip method of note taking is best. I also find myself making more and more use of the library each year in the assignment of collateral readings in connection with the regular lecture work. I believe that no part of an education is more important than acquiring a familiarity with books, in order to know where to look for information when it is needed. This work is, of course, best suited to the needs of advanced students, but even the farmer boy, who comes in for twelve weeks of practical work during the winter, may profit much by it. In most cases he will be found as ignorant of the literature that is readily within his reach as the advanced student or teacher is of the broader literature to be found only in connection with the larger libraries. In many of the younger institutions the libraries must yet be small, but time and money will remedy this, and money can scarcely be better invested. Meanwhile, it is safe to say that even the smallest library, well used, can do much for the student.

Laboratory work in horticulture.—Laboratory work in horticulture seems to be almost wholly confined to the practical operations of horticultural work and the facilities to the common implements in horticultural usage. Very few mention any microscopical work. Experimental lines, observations, and statistical work among neighboring growers and classification of cultivated plants each receive one mention. Drying ovens and instruments for measuring and weighing are once mentioned.

It is just in this matter of laboratory work that many of us are perhaps most in the dark as to what to do. Practical work very properly forms the basis of it, but during much of the college year outdoor work is not available and the common indoor work is soon exhausted or made to become a mere mechanical repetition, which is still worse. I think we all feel the need of help at this point. The library is a never-failing accompaniment, but this can be utilized at other times. There can be no doubt that an abundance of experimental work of great value to the student would be perfectly feasible if we only had the matter worked out, and we are waiting for the man who has the time and ability to do it.

One man mentions among his laboratory facilities apparatus for mechanical analysis of soils, tubes for demonstrating capillarity, osmosis apparatus, root pressure gauge, hygrometer, and an originali nvention for measuring transpiration, auxanometer, and color screens. Perhaps here is a hint as to some of the lines that might be introduced. In many cases the questions relating to soils can doubtless best be treated by the professor of agriculture and the others mentioned by the professor of botany. If so, all the better; but ought not we, as horticulturists, to see that those of our students who want real horticultural training have the chance of getting such things as these somewhere?

Horticulture as a culture study.—One of the questions asked was, "Do you attempt to make horticulture in any sense a culture study?" To this 16 replied yes, 4 say no, and 9 say that only incidentally it is so. Several did not answer or did not understand the meaning of the question. One reply, from the far Western coast, covers the ground so well that I wish to quote it. The writer says, "Yes; constant allusion is made to the relation of the art to the higher education and its services to the biological sciences and its dependence upon advanced scientific work for its own advancement." This, it seems to me, recognizes the subject in its true position. We are constantly emphasizing the need of culture and training, and many have long looked upon the classics as prime essentials to that end. Happily, we are more and more coming to see that not all culture is confined within doors that can only be unlocked with a Latin grammar or a Greek lexicon. We are finding out that science offers breadth of training as well as the humanities. Why should it not, since in it we study the supreme wisdom as revealed to man to-day rather than that same wisdom and power as revealed to and through man in past ages?

In horticulture we have a subject preeminently fitted to minister to the needs of the student, while giving him culture and breadth of training as well. It not only,

in company with agriculture, deals with those functions of life by which inorganic matter is changed into organic and useful material, but it is able to throw powerful search lights upon many philosophical and biological questions which must ever be of keenest interest to humanity. Furthermore, in the study of landscape gardening we deal with one of the noblest of fine arts, since in it we induce nature herself to paint us the picture which shall interpret her deepest expressions and her highest beauties. I am fully convinced that the subject of horticulture, or at least some phases of it, may well occupy a place in any liberal education, or in any educational curriculum, regardless of its connection with the general idea of agricultural training. The broadening influences of its biological side and the æsthetic and spiritual influences of its ornamental side fully warrant such recognition. If landscape gardening found a proper place in the course of study of all the normal and teachers' training schools throughout our land it would not be many years before our country schoolhouses, and many of our country homes, would cease to be the dreary and cheerless places that they now are.

The practical value of such a subject is much more apparent and much more likely to take a tangible hold upon the minds of people, yet even this should warrant careful consideration in almost any course of study. Why should it be less desirable or less genteel for the young man or the young woman to learn some lessons from the fine art of nature herself, which will enable him or her to render the surroundings of the home continually attractive, than to spend numberless hours in learning to paint pictures which may adorn its walls, or in acquiring some ancient classic which may adorn but a dark corner of the memory, to be ILLUMINATED only by dim and infrequent flashes of recollection? We are not likely to overestimate the practical side of this work, and we should emphasize it in every way that we can, but let us not forget our opportunity in its broader field of human ken.

Number of students in horticulture.—No accurate report as to the exact number of students who received horticultural instructions during the last year can be given, since many failed to give a definite reply. Certain it is that over 1,000 were enrolled in the various horticultural classes of the United States. Naturally those agricultural colleges which offer only one or two courses, and which require all, or nearly all, of their students to take this subject, report the largest number. Kansas leads with 197, followed by Mississippi with 160, while several of the newer institutions, and indeed two or three of the older ones, report none. In several cases the numbers reported were all, or nearly all, short course or winter students, while in some they were all, or nearly all, regular college students.

It was asked what proportion of these students probably took horticulture because they were really interested in the subject. This could of course be only a matter of judgment, and was evidently in some cases much influenced by the personal equation of the professor. The answers ranged from 50 per cent to all, more saying all than anything else. I think that most of us will agree that when the greater part of the students in an institution are required to take any subject, e. g. mathematics, to say that all take it because they want it is to misunderstand student nature. Of the twenty-six different college students who took horticulture in the University of Nebraska not one was required to take it, and since they elected it all might be fairly said to have taken it because they were particularly interested in the subject. Yet all familiar with elective work know that the need of a certain number of additional hours at a convenient time often influences such choice as much as particular taste. However, the reports indicate that a goodly number of young people throughout our land are really interested in this subject.

Horticulture as required or elective.—Horticulture is required in the agricultural course of every institution but one; in that one it is elective, but in the agricultural course only. It is required of *all* students in three. Eight report it as elective to other students, while fourteen report it as not elective to students outside the agricultural course, and a few say that it is only elective to graduates, specials, or to some limited class of students. Is not this a question which should receive attention? Why should a student be deprived of the opportunity to get horticulture because he is not classed in the agricultural course? To my mind the ideal condition is that in which the course stands on the same plane and takes its chances with all other subjects, where any student is free to elect it if he will, but where no requirement and no special inducement constrains him to elect it. Among the students registered for horticultural work at the University of Nebraska at the present time there are representatives of seven different courses—the general scientific, the biological, the philosophical, the literary, the classical, the English, and the agricultural.

Possible improvements in teaching horticulture.—Suggestions were asked for as to possible improvements in methods of teaching horticulture, but to explain and enlarge upon these would manifestly be impossible within the present limits. Among the things mentioned were more apparatus, more laboratory work and better laboratories, more field work, better grounds for illustration, observation tours, more time, text books, better preparation, more required work, work placed earlier in the course

(this from an institution where it is only open to seniors), deciding upon a definite basis of instruction, so that it shall be either the manual training or the philosophical basis, but not an attempt to mix the two, narrowing the field which one institution tries to cover, better teachers, and finally students to take the work.

General character of experimental work.—So far as a single question and the replies to it can indicate the greater part of experimental work in horticulture and botany is along important lines, requiring some considerable length of time for their solution. This is encouraging, for it indicates that the pressure for immediate results, so often felt by the station workers in the early history of the work, is giving place to an expectation for deeper and more substantial work. There are, to be sure, many practical questions which can be taken up in connection with the more important lines and be made to yield results of value in a short time. These may well receive attention when they do not interfere with more important work.

Variety testing.—In regard to variety testing, nineteen report that they give a good deal of attention to this work, six say a moderate amount, and twelve say that they give little or none. Eighteen say that growers demand this sort of work from the station, twelve say that it is not or only slightly demanded, five say that information about varieties is demanded, and at least six mention that seedsmen and nurserymen demand it. In general, the facts appear to be that farmers and fruit growers want information as to what they may safely and wisely plant, while the dealers and tradesmen want the real variety testing in order to aid them in their sale of novelties.

On this subject one worker very aptly says: "Variety testing is apt to run into an advertising scheme for seedsmen and nurserymen. We are often annoyed, after our work is set for the year and at a time too late in this climate for any fair test, to receive from growers and dealers samples of seeds and plants for test. Then the following fall they write for a private report as to how their plants have turned out. I have adopted the rule never to give anyone a private report in regard to any seeds or plants sent to us. Variety testing is incidental to our work and not an object. We have little call for it from our own people, but much from growers and dealers in other States, who, as I have said, want it mainly for advertising purposes, and I strive to prevent this."

I am sure that many other workers have experienced this same phase of the problem. It is apparent that in this as in many other matters practical growers merely expect the station to serve as a bureau of information. It seems to me that if this principle is fully recognized it will materially aid in solving the vexed question of the importance or need of this work, for it is not always necessary that the station test the varieties in order to get the information.

Variety testing is naturally demanded more in the newer States than in the older, and the reason oftenest given why growers demand it is that the State or horticulture in the State is new. Other reasons mentioned are that tradesmen's statements are unreliable; that the growers need the information; that they deem this the work of the station; that this is a class of work which they can understand; that they fail to see that results are local, etc. One horticulturist says: "We find this the most popular feature of our work—one that attracts the attention of the general public most readily, because it is the one that they can most readily understand. They demand variety testing as an object lesson which they are unable to indulge in themselves without considerable individual cost. We deem it the most uncertain, unreliable, and unsatisfactory feature of our work, but are compelled to indulge in it to popularize the station." Replies from several others indicate that they are discarding it as fast as feasible.

Dissemination of seeds and plants.—Twenty-two workers report that more or less has been done by their station in disseminating seeds or plants, while fifteen say that nothing, and three say that a very little in the way of their own productions has been sent out. In a majority of cases they were sent free, though some have asked the cost of transportation and packing or of propagation, while a few have sold at a fixed price. Among those who have tried it six say they think it wise and eight consider it unwise. Three consider it unwise to send them free, and several others say that it is undesirable except for cooperative experiments or with very careful handling. In fact nearly all who consider it wise make the statement with some limitations annexed. Of those who have not tried it, two say they think it would be wise and five think it would not. It is quite evident that the majority both among those who have had experience and those who have not think it an unwise practice. New Jersey reports sending out weed seeds to farmers at a fixed price and thinks the results are good.

Experimental work of the year.—To give any satisfactory mention of the different lines of experimental work carried on by the horticulturists and botanists during the year is utterly impossible within the limits of this paper. Variety testing, being the commonest and most convenient line of work, naturally receives more frequent mention than any other line. Following this come experiments with plant diseases, fertilizers, plant breeding, spraying, cultural experiments, vegetable forcing, and insect

depredations, each of which receives mention several times. Other things mentioned are experiments with cañaigre, crown gall, orchard tillage, grafting of hickories, root pruning, crossing, propagation, climatic seed tests, irrigation, windbreaks, apples, potatoes, rate of timber growth, winter protection of fruit buds, potency of pollen, apple blight, methods of tree planting, study of the codl.n moth, corn selection, cucurbits, thinning apple trees, greenhouse fertilizers, bulb growing, soil treatment for nematodes, peach diseases, sweet potato rot, grain and corn smut, seedling fruits, peaches, pollination of plums, preservation of fruits by alcoholic vapor, cereals, forage plants, effect of hot water on germination, greenhouse work with flowering plants, physiological effect of different chemicals on potatoes, etc. Colorado reports a careful study of the flora of the State, with especial reference to weeds and grasses; New York a horticultural survey of the State, while the Pennsylvania horticulturist has spent much time in traveling among the growers of his State to become better acquainted with their needs. These, of course, include only the more important lines, and do not begin to cover the problems taken up by the different workers. They are very encouraging, for they indicate that the stations are covering a much broader field than formerly, and that the results of their work must become more and more useful to the people interested.

Proportion of experiments which fail.--In reply to a question as to what proportion of experiments fail to yield definite results owing to climatic or other unfavorable conditions, nearly all report some such loss. A number say that the proportion is small; about as many say that the loss is considerable, perhaps one-fourth, while others report varying proportions up to one-half. At least three say that one-half their results are lost from one cause or another. Only two say that they meet no such loss. Several say that they now try to avoid lines in which losses are most frequent.

Station workers are sometimes criticised because they do not show more results of their effort, but it should be remembered that in general they are just as much dependent upon natural conditions and phenomena as the farmer himself, even more so in many cases, and are just as likely to meet with failure in their work from these causes as he is in his.

Time demanded by outside work.—The station worker is not allowed to pursue his work uninterruptedly. There are many outside demands upon his time. Only five of all the horticulturists and botanists replying to the questions say that none of their time is occupied with work at farmers' institutes, though fifteen say that this demand is but slight. At least twenty-four report varying amounts of time which show that this work demands a good deal of attention. As many as eleven report from three to four weeks thus spent, while five say that from one to two months are required at institutes, fairs, and horticultural meetings. None of our members appear to be suffering for lack of something to do.

Appreciation of the work.—Nearly all workers feel that their work is generally appreciated by the people of their State, or at least by those who know it, and that it is growing in appreciation. Only two say that it is not well appreciated, and two that it is not very highly valued, but in all these cases they report that the conditions are improving. One worker in a new State says that the people rely too much on the station.

Bulletins issued.—As a matter of statistics it may be said that some seventy-five or eighty horticultural bulletins and over thirty botanical bulletins were issued between July 1, 1895, and July 1, 1896. Aside from this, much matter is published in annual reports and other places. In one or two States everything appears in the annual report.

Two replies from across the border indicate that the Canadian workers are in harmony with us in methods and in the general scope of the work which they are trying to cover.

In closing, I feel that I should apologize to the botanists for the fact that in this report greater attention is given to horticulture than to botany. This is partly due to my own greater familiarity with the horticultural work, and partly to the fact that horticulture, being educationally the younger subject, has greater need of attention.

FRED W. CARD, *Chairman.*

The CHAIRMAN. Unless there be objection, we will consider this very interesting report accepted, and I will now call upon J. W. Lawrence, of Colorado, to present his report on mechanic arts.

REPORT OF THE SECTION ON MECHANIC ARTS.

In making out this report I have endeavored to present such matter as might be regarded as evidence that the work in the mechanic arts side of the agricultural colleges is moving forward to better and more substantial work, or at least is not slipping behind.

Some time ago I sent out a circular letter making practically only two inquiries, one as to what advance, if any, had been made in the studies and work of the departments operating along the line of the mechanic arts; requesting also that the general condition of the work be stated.

Knowing that many were interested in the two bills lately presented in Congress, known as the "State engineering and experiment stations bill" and the "Wilson-Squire engineering and education bill," I made inquiry as to how they are regarded by the different colleges, and what had been done by each toward the advancement of the bills.

The replies were prompt and courteous. Upon inspecting the answers received and looking over the courses of study offered, I find that there seems to be a wide difference in the constitution of the curricula. At one end of the list are colleges having a course of study scarcely better than that of a high school, while at the other are found those whose requirements for admission would demand the completion of a first-class high-school course.

One college reports having endeavored to establish, by a great and radical change, a course that should be, in fact as well as in name, a college course. The experiment was tried, and the consequence was that they found themselves with depleted ranks and were forced to retreat to their former position. They found that the students coming to them had not the necessary preparation, and that the stand taken for a higher grade of work failed to bring about any noticeable improvement in the class of students coming to them for admission. I have received this complaint from more than one source; and those who have answered the query as to why this is so agree that it is on account of the schools of lower grades not furnishing students with the required amount of preparation.

Acting on the assumption that "the colleges are made for the people," a number of the institutions report that, in order to afford such students an opportunity to acquire the needed preparation, they have introduced preparatory and subfreshman courses, which give a thorough preparation about on a level with a good high-school course. It is noticeable that these complaints of lack of preparation come from colleges situated in a new or sparsely settled part of the United States, although an exception is noted in one of the older Middle States, where the professor reporting declares that the poor scholarship shown by those applying for admission is due to the poor public-school system in that State.

Therefore it will appear that we shall have to return to the proposition that "the schools were made for the people and not the people for the schools."

This is one of the points that seems to have been brought out by my inquiries, and while this Association has done much to improve the college courses of study there is still much to be accomplished through its instrumentality. I am firmly convinced that, no matter how good a technical education a man may have, if he is lacking in sound, broad culture and an adequate knowledge of the English language he will be outclassed by the technical man possessing the latter qualifications, especially if he is to teach in the colleges of the country.

I am impelled to dwell somewhat upon the foregoing because there is an evident desire in the mechanical departments of the colleges, and more especially in the younger ones, to raise the standard of scholarship, and to be fair to the students in so doing.

Judging from the letters received, there appears to be a commendable interest taken in the matter of courses of study, and I am sure great good must result from these efforts.

With regard to attendance upon courses lying along mechanical lines, there appears to be no lack of students who desire to take up the work, especially where the course is a separate and distinct one.

There is a growing desire to make a plainer line of demarkation between the agricultural and mechanical courses, and have each stand on its own merits, and not have one used to support the other. There are some distinct exceptions to this, however, and some institutions are using the mechanic-arts feature simply as a supplement to the agricultural work, while there are others which have the two courses closely woven together. Time will doubtless develop which is the best method to pursue.

Then, again, the question seems to present itself whether it is better to make a simple mechanic-arts course out of it or to develop the work into the highest kind of engineering.

Some of these questions are such as might, perhaps, come under the caption of "A course of study;" but I am bringing them to your attention because they are points which have developed in this inquiry as being those upon which much activity is manifested by the mechanical sections, and much progress is being made toward the strengthening of the work.

As an example, one of the younger colleges reports, "We do not now admit any students to the mechanical-engineering course except college students. No academy students are given work of any kind in the department.

"No shop work is given to students other than mechanical-engineering matriculates.

"Every graduate from this department (thirteen) has a position directly along the line of mechanical engineering. We graduate nine more this year."

As to numbers in attendance, there is a universal response that the numbers are increasing, and that, too, at a most gratifying rate. Some report that the increase of numbers is in excess of the facilities for instruction. One example will illustrate:

One college says: "So far as the work in the mechanic-arts department at this institution for the last year is concerned, the attendance was only limited by the capacity of the shops. One hundred and seventy students took work in the shops, besides a senior class of eighteen who did a large amount of advanced laboratory work in the way of testing engines, boilers, etc., calibrating various engineering instruments, and testing the strength of the common materials of engineering.

"The interest in this line of work is growing rapidly at this institution. If our attendance increases as rapidly in the next three years as it has in the last three years we will be entirely unable to handle our classes with the present facilities, even if we should entirely revise our schedule of recitations, and carry on the shop work all the time."

The increase of the material equipment of many of the institutions during the past year is also in evidence as being a direction in which much progress has been made. Some institutions report the addition of new benches and tools; some the building of additions to plants already existing; others that they have put up entirely new buildings for the accommodation of the department.

One college reports the erection of a fine mechanical building, and the fitting up of the same, at a cost of $198.000—the most costly one mentioned as having been completed during the past year.

The amount of time devoted to shop work in the various colleges formed another interesting feature of the replies, but that may more properly come before the Section on Mechanic Arts, and I will not occupy the time by discussing it now.

The kind of work given is also of importance; it varies considerably, and might at some time properly come before some section of this Association for discussion. My inquiries developed the fact that many of the institutions are gradually introducing experimental laboratories for work in both mechanical and electrical engineering.

Some have already had them in successful operation for many years, and among the newer institutions there seems to be a growing desire to have them. Those lately established are started in two different ways; some are fitted out in one or more existing rooms that have been remodeled for the purpose, while the others consist of buildings built especially to receive appliances designed to be used for purposes of experimenting along mechanical and electrical lines.

This brings me naturally to the last feature of my report, the "Wilson-Squire engineering and education bill," and the "State engineering experiment stations bill." In presenting some points regarding these bills at this time, it is not my purpose to usurp the functions of any existing committee, or in any way to trespass upon the territory of anyone who may have something to say upon the subject.

I was somewhat surprised and much gratified when I received replies to my inquiries to find how hearty the responses were, and to know that so much lively interest was manifested in regard to the bills. College presidents and department professors nearly all most heartily indorse the measures. A good many wanted the bills modified somewhat, but the latest revision of the bills will remove the cause of most of the objections. By far the greater number are in favor of the "State engineering experiment stations bill" in preference to the "Wilson-Squire engineering and education bill." I have been urged by many to bring this matter of the "engineering experiment stations bill" prominently before the convention at this time, as a matter affecting all the land-grant colleges. I am constrained to believe, however, that a great deal of earnest work has already been done by the trustees, presidents, and professors of the various colleges, and that, as a rule, they are already fairly well informed regarding the purport of the bill; therefore, as it would take some time to get the matter in proper shape for discussion, I will refrain from presenting much matter that is explanatory, except to say that I think that the bill is the logical sequence of previous legislation. It is similar to the Hatch Act. It provides for experiment stations for engineering, in the same manner as agricultural experiment stations are provided. I also believe that it would not be in accordance with the rule of the Association requiring this report to inject a large amount of matter relating to this subject.

Many of the professors in the mechanical departments have expressed themselves as being very desirous of attending these meetings and exchanging ideas with their fellow-workers. Why are they not present the same as the professors from the other college departments? Could not this be brought about? Can not the college presidents and trustees present see to it that more of the mechanical men are present at these meetings? I am sure much good would come of it, and it could be made mutually beneficial. The discussion of technical papers in the section, the comparison of methods, and the discussion of topics arising incidentally would be features which would accrue to the benefit of all.

J. W. LAWRENCE, *Chairman.*

The CHAIRMAN. If there be no objection, the report will be considered as approved, and I will call next for the report of the treasurer, J. H. Washburn, of Rhode Island.

REPORT OF THE TREASURER OF THE ASSOCIATION.

John H. Washburn, treasurer, in account with the Association of American Agricultural Colleges and Experiment Stations.

Balance on hand from last year	$565.88
Dues for 1895–96	930.00
	1,495.88
Total expenditure	1,020.43
Balance on hand November 10, 1896	475.45

ITEMIZED STATEMENT.

Receipts.

Experiment stations in Alabama, Arizona, Arkansas, California, Colorado, Connecticut (State and Storrs), Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York (State and Cornell University), North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, Washington, Wisconsin, and Wyoming, $10 each	$490.00
Colleges in Alabama, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Virginia (A. and M. College and Hampton Normal Agl. Inst.), West Virginia, Wisconsin, and Wyoming, $10 each	440.00
Total	930.00

Expenditures.

1895.

Voucher 1.	Paid C. P. Gillette, expense of entomological committee	$4.00
2.	Paid E. L. Wepf, for 300 lists of members	5.00
3.	Paid Forden, Pratt & Co., expense of lecture	15.00
4.	Paid J. H. Washburn, incidental expenses of executive committee	4.25
5.	Paid J. E. Thomas, official stenographer	11.28
6.	Paid Judd & Detweiler, for printing	10.70
7.	Paid C. Gregerson, for printing	5.50
8.	Paid Carpenter & Morehouse, printing	3.00
9.	Paid H. H. Goodell, committee expense	13.43
10.	Paid H. H. Goodell, committee expense	27.30
11.	Paid H. S. Gardner, printing	11.68
12.	Paid L. M. Brown, typewriting	1.75
13.	Paid S. H. Gardner, typewriting	1.86
14.	Paid H. C. White, committee expense	53.00
15.	Paid Ebbitt House, committee expense	17.50
16.	Paid Carpenter & Morehouse, printing	11.25
17.	Paid J. C. Hall Co., printing	3.25
18.	Paid Ebbitt House, committee expense	59.75
19.	Paid H. C. White, committee on examination	67.55
20.	Paid Spring-Emerson Co., printing	4.75
21.	Paid H. H. Goodell, committee expense	31.37
22.	Paid H. P. Armsby, committee expense	19.44
23.	Paid M. A. Scovell, committee expense	40.65
24.	Paid L. M. Brown, duplicating and typewriting	11.40
25.	Paid H. H. Goodell, committee expense	43.68
26.	Paid H. C. White, committee expense	65.10

Voucher 27.	Paid A. W. Harris, committee expense	$61.74
28.	Paid Thomas J. Hunt, committee expense	37.85
29.	Paid H. C. Murkland, committee expense	33.48
30.	Paid A. W. Harris, committee expense	16.45
31.	Paid G. E. Stratton, convention notices	2.25
32.	Paid J. M. McBryde, committee expense	30.05
33.	Paid Carpenter & Morehouse, printing	1.25
34.	Paid H. H. Goodell, committee expense	35.71
35.	Paid H. H. Goodell, committee expense	34.85
36.	Paid W. M. Hays, committee expense	41.00
37.	Paid D. Gillis, printing	10.00
38.	Paid J. H. Washburn, incidental expenses at Denver for printing and postage	39.95
39.	Paid Carpenter & Morehouse, printing	8.00
40.	Paid L. M. Brown, typewriting	1.75
41.	Paid M. E. Eldred, typewriting	5.00
42.	Paid H. H. Goodell, committee expense	12.66
43.	Paid Carpenter & Morehouse, printing	10.00
44.	Paid H. C. Burch, Grand Army Hall	75.00
45.	Paid J. H. Washburn, correction	20.00
Total		1,020.43

The CHAIRMAN. It is generally customary to appoint an auditing committee to examine the report of the treasurer. For that duty I will appoint C. D. Woods, C. F. Allen, and J. E Stubbs. (For report, see p. 68).

Reports of committees are now in order.

Mr. MURKLAND (chairman of the committee on entrance requirements, courses of study, and degrees). Mr. Chairman, inasmuch as there is a possibility that there may be differences of opinion on some of these matters, and as the time now is short for a full discussion, I move that this report be specially considered at some future time, and printed, in order that it may be laid directly before the members of the convention.

The motion was adopted.

The CHAIRMAN. There not being time this morning to listen to further reports of committees, it is proper now to take up the consideration of the organization of a permanent Section on Irrigation, for which petition has been duly made, signed by seventeen members.

Mr. PATTERSON. I move that the permanent organization of a Section on Irrigation be made.

Mr. ATHERTON. I move that the whole matter be laid upon the table for one year.

After a short debate the motion of Mr. Atherton prevailed by a rising vote of 29 to 16, and at 11.45 a. m. the session adjourned.

EVENING SESSION, TUESDAY, NOVEMBER 10, 1896.

The general session convened in the Grand Army Hall at 7.30 p. m., Vice-President R. H. Jesse, presiding.

The CHAIRMAN. The first thing before the convention is the unfinished business. At the morning session we decided that the recommendations of the executive committee should be taken up one by one. The chairman of the executive commiteee will read them.

Mr. GOODELL. The first recommendation is as follows;

That a committee be appointed to wait on the War Department and adjust relations between it and the colleges. A disposition has been shown to ignore expressed preferences in the detail of officers for college duty, and the Adjutant-General of the Army, in his late report, has recommended that details be made only to those institutions showing on their rolls the presence of one hundred and fifty, or more, students.

Mr. STUBBS. I move that a committee of three be appointed by the chair in accordance with the recommendation of the executive committee.

Carried. (For committee, see p. 47).

Mr. GOODELL. The second recommendation is:

That the Association calls the attention of all concerned to the limitations of the franking privilege granted experiment stations. The law is explicit, providing only for the franking of bulletins, and college reports containing the annual reports of stations. Great care should be observed by station officers not to abuse this valuable privilege so very necessary to the work of the stations.

Adopted.

Mr. GOODELL. The third recommendation is:

That the chairman of the section and the editors of the proceedings of the convention be constituted a committee to pass on the papers from each section, and that the Department be urged to print the papers recommended by this committee.

Adopted.

Mr. GOODELL. The fourth recommendation is:

That station directors drop from their mailing list the names of workers in other stations and depend entirely upon the list furnished at Washington, sending for a fresh copy at the time of issuing each bulletin. Changes among station workers are so frequent that the observance of this practice would result in a great economy of time and correspondence, besides securing greater accuracy. Why should directors send out notices of every change to 51 stations, and why should these 51 stations be compelled to make the necessary changes when it is done so much easier once for all at the Office of Experiment Stations?

Adopted.

Mr. GOODELL. The fifth and last recommendation is:

In view of the large and increasing number of measures which are introduced in Congress affecting the interests of the colleges and stations, and the frequent lack of cooperation among those interested concerning such measures, whereby the influence of the Association and the interests it represents are liable to be materially weakened, the committee respectfully recommends that institutions, members of the Association, and their officers, refrain from advocating measures affecting the interests of all until such measures shall have been considered and approved by the Association.

Adopted.

The CHAIRMAN. New miscellaneous business is now in order.

Mr. GOODELL. I move that a committee of five, one of whom shall be the Librarian of the Department of Agriculture, be appointed to consider the subject of indexing agricultural literature and report upon the feasibility of the same.

Carried. (For committee see p. 56.)

Mr. ATHERTON. I move the adoption of the following resolution:

Resolved, That a committee of four, of whom the chairman of the executive committee shall be one, be appointed by the executive committee to await upon President-elect McKinley and present to him the importance of such an organization and administration of the Department of Agriculture as will give unity and permanence to all its scientific work and keep that work free from political influence.

Adopted. (For committee see p. 68.)

Mr. ATHERTON. I move that the officers of this Association communicate with the President of the United States, to see whether it will be agreeable for him to receive this Association in a body.

Carried.

Mr. WHEELER. I desire to introduce the following resolution:

Whereas some experiment station workers have failed in certain of the station publications to cite authorities for statements made and to give proper credit for work done by others, and in consideration of the unfavorable light in which the work of the stations must be viewed by scientists in consequence: Therefore be it

Resolved, That this Association considers such a course unscientific and not conducive to the best interests of the experiment stations of this country.

Referred to executive committee (see p. 47).

Mr. ALVORD. As subcommittee in charge of the matter of procuring busts of Hon. Justin S. Morrill for several colleges ordering the same, under action taken by the

Association at its Washington convention of 1894, I now respectfully submit the following report:

After the subscriptions verbally made at the convention mentioned by representatives of several colleges had been confirmed in writing, arrangements were concluded with Mr. Preston Powers, of Florence, for making a marble bust of Senator Morrill to be owned by the Association, and from this twenty-five casts in plaster. Every cast was to be finished by the sculptor and personally attested by him, and the casts and marble to be packed separately, one in a case, and delivered in New York City, transportation charges paid.

Great delay occurred in executing the work, more than twice as much time being occupied as at first agreed. But it appears from explanations made by Mr. Powers that the delay was entirely unexpected and due to unavoidable causes, for which the contracting sculptor should not be held responsible.

The marble and the casts ordered were finally received at New York during the month of October last and eighteen casts were at once forwarded to the subscribing colleges which had paid for the same as called upon, and were shipped in accordance with instructions respectively received.

Of the institutions making verbal subscriptions in November, 1894, three failed to confirm the same in writing and were dropped from the order list. In response to a circular of inquiry sent to all colleges acting with the Association, a few additional orders were received for casts. Some of the institutions which ordered casts have not yet responded to the requests made to them by letter for payment upon the consignment of the casts from Italy, as originally agreed with the sculptor.

As a result, there are now at New York, stored and insured, subject to the order of the Association, seven plaster casts and the marble bust.

It is recommended that one of the casts be presented to Mrs. Justin S. Morrill in the name of the Association, to replace the plaster bust of Senator Morrill borrowed from her for the collective college exhibit made by the Association at the Columbian Exposition and which was broken while in the hands of the transportation companies for return to its owner. Also, that of the six casts remaining, the colleges ordering them in writing be given thirty days' notice, during which they may be paid for and claimed at the original rate of $45 each, with proper charges added for storage and insurance, and that after the expiration of this limit other colleges which may apply be furnished the same in the order of their applications upon payment of $50 for each cast, delivered packed and "f. o. b." at New York City.

Mr. Powers, the sculptor, has retained in his studio at Florence the original mold and the first cast made from the marble. From these other plaster casts can be made, and, as he states, equal to those now supplied. It is recommended that the executive committee be authorized to contract with Mr. Powers for the making of casts of this bust hereafter only upon orders given for and in the name of this Association, and that they be supplied to colleges at not less than $50 each, delivered in New York, any margin of profit to be covered into the treasury of the Association. This will reimburse the Association for expenses now incurred in this connection, which will somewhat exceed the amount received for the casts already ordered.

The fine marble bust of Senator Morrill by Powers is the property of the Association, and this convention should provide for its proper disposition. It is suggested that the executive committee be authorized to temporarily deposit the marble in the Corcoran Art Gallery at Washington, and also to provide for presenting it at a suitable time to the Congress of the United States, to be permanently placed in the Senate Chamber, with an appropriate inscription on behalf of the Association.

An account of the receipts and disbursements made by the undersigned as subcommittee for this purpose will be made as soon as a letter now due is received from the sculptor. It is requested that the new executive committee be authorized to receive and audit this account, and if found correct, to direct the treasurer of the Association to adjust the same. And I also request to be relieved from duty as committee in charge of this matter, after the settlement of the account.

Respectfully submitted.

HENRY E. ALVORD.

The report was accepted and its recommendations adopted.

Mr. WASHBURN. I have here a letter from the secretary of the Cosmos Club, extending to the members of this Association while here in the city, the privileges of the club. The secretary of the Association was directed to write a letter of thanks accepting the invitation.

Mr. ALVORD. I move that the Association send a letter of respect to Senator Morrill, and ask him to attend the meetings of the Association.

Carried.

Mr. HARRIS. I wish to offer the following resolution:

Resolved, That a committee of three college presidents be appointed by the executive committee to cooperate with the secretary of the Association in revising and publishing a table of the college statistics similar to a table published some years ago.

That the committee be directed to publish the table not later than December 7, 1896, if possible, and if not, to publish at that time such statistics as may be available, and the perfected table as soon thereafter as may be found practicable.

Referred to the executive committee (see p. 47).

Mr. ATHERTON. I desire to present the report from the committee on House bill 3618 (Senate 735) to establish and maintain courses of instruction in naval engineering in the scientific and technological schools of the United States and for other purposes. Your committee trusts that the report will meet the approval of the Association.

REPORT OF THE COMMITTEE ON A BILL TO ESTABLISH AND MAINTAIN COURSES OF INSTRUCTION IN NAVAL ENGINEERING.

History of the measure.—This bill is based upon Senate bill No. 2779, introduced in the Fifty-first Congress, first session, by Senator Butler, of South Carolina, and Senate bill No. 1289, introduced in the Fifty-second Congress, first session, by the same Senator.

At the convention of this Association, held at Champaign, Ill., in November, 1890, after a careful and prolonged consideration of the measure by the college section, with special reference to its bearing on the interests of the colleges represented in the Association, followed by a full discussion of the report of the section on the floor of the convention, a committee was appointed, consisting of Messrs. Atherton, Smart, and Dabney, to present to the proper committee of each House of Congress the judgment of this Association in support of the measure. This was the first movement of an organized body in behalf of the bill, though many institutions and individuals had already given it a most cordial and emphatic indorsement, such as the State universities of Tennessee, Michigan, Wisconsin, Illinois, South Carolina, and Ohio; Madison (now Colgate) University, Hamilton, N. Y.; Purdue University, Indiana; the Worcester Polytechnic Institute, Massachusetts; St. John's College, Annapolis, Md.; the Pennsylvania State College, the University of Pennsylvania, and others.

Your committee received a most courteous and cordial invitation to appear before the Senate Naval Committee. Their presentation of the matter was listened to with great attention and called forth an extended colloquial discussion, which appeared to enlist the hearty favor and support of the entire committee.

The Naval Committee returned the bill to the Senate with a strong report (No. 576, Fifty-second Congress, first session) in favor of its passage, but the pressure of other matters prevented it from being reached during that Congress. For that reason your committee failed to make a report at the next convention of the Association, as it seemed hardly worth while to do so at that stage of proceedings.

In the Fifty-third Congress the bill was not introduced, but at the opening of the Fifty-fourth Congress it was again brought forward, with such additions and modifications as subsequent experience and reflection had suggested.

Your committee then resumed its efforts to carry out the instructions of the Association, the vacancy caused by the appointment of Dr. Dabney in the Department of Agriculture being filled by the executive committee by the appointment of President H. C. White, of Georgia. Owing to the absence of the chairman the burden of the work fell on Messrs. Smart and White, and the credit for whatever was accomplished belongs to them.

As the provisions of the Wilson-Squire bill include all that was important in the earlier bills, and as the arguments in support of each measure are substantially the same, the present report deals only with the bill now pending.

Essential features of the bill.—The prime purpose of the bill is to increase the number of engineering officers in the Navy to such an extent as is required by the recent large increase in the number of ships of war, and the total change occasioned by the substitution of steam for sails as a motive power.

To those who have not given attention to the subject it must seem well nigh incredible that a great and powerful Government should undertake to reconstruct and enlarge its Navy so as to make it commensurate in extent and quality with the requirements of its position among modern nations; should institute a careful and prolonged series of experiments and expend many millions of money for the purpose of providing its new vessels with an armament representing the highest achievements of scientific construction; should fully and unequivocally recognize the fact

that sailing vessels have been absolutely superseded in modern warfare, and should, accordingly, spend other millions in fitting up its new vessels with engines and machinery fit to be models of their kind; should thus recognize the fact that the engineer has come to take, in great part, the place of the sailor in the Navy, even more than in the merchant marine; should continue under the changed conditions to train the same number of officers of the line as when such officers constituted the sole, or almost the sole, official complement of a ship of war. But while thus clearly recognizing a total change of conditions, should yet take no single step to increase the number of that branch of the official force upon whose intelligence and skill and courage and training the efficiency and even the safety of the war vessels absolutely depends. Yet such is the fact, as it has been annually presented to Congress for several years past in successive and urgent reports of the Secretary of the Navy, the Chief of the Bureau of Navigation, and the Chief of the Bureau of Steam Engineering.

Extract—Report of Secretary of Navy, 1890, urging an increase in the Corps of Naval Engineers —The Secretary of the Navy, in his annual report for the year 1890, said:

"Of equal importance with the above changes is the demand for an increase in the number of the Engineer Corps. At present there are not enough engineer officers in the Navy for ordinary working purposes, and if no additional ships were building, an enlargement of the Corps would be necessary. The important additions that are now being made to the fleet emphasize still further the urgent necessity of immediate action. The engines of the new ships, with their great complexity and delicate adjustment, require the highest kind of expert treatment, and unless a sufficient force is provided the safety of the ships will be seriously endangered. A bill for this purpose has been introduced in Congress, which provides, also, for the selection of a certain number of graduates of technical schools for appointment in the Engineer Corps. With the general principles underlying this bill the Department heartily concurs, and it earnestly asks that action may be taken upon it at the coming session."

Extract—Report of Secretary of Navy, 1891.—In 1891 the Secretary of the Navy, recurring to the same subject, referring to and reaffirming his previous report, said:

"It was then stated that there were not at the time 'enough engineer officers in the Navy for ordinary working purposes, and if no additional ships were built an enlargement of the Corps would be necessary.' A modern man-of-war is a vast and complex machine, needing intelligent and trained minds to insure a perfect working of the parts, failure in any one of which may be fatal at a vital moment; and the sense of responsibility, the physical and nervous strain upon the engineer officer charged with the care and supervision of this network of machinery is very great. His duties are not only of the highest importance, for upon him mainly depends the efficiency of the motive power, but they are at the same time arduous and dangerous. Manual labor and subordinates are at his service, but he can not be everywhere, and he should have the assistance of men like himself to bear their share of his load.

"It is false economy to put in our new vessels all that is most advanced in high-pressure machinery and the multitude of engines and devices by which steam and mechanical appliances are made to do the work of man, and then to provide an insufficient number of officers to contol them."

Extract—Report of Commodore George W. Melville, Engineer in Chief, 1889.—The distinguished Chief of the Bureau of Steam Engineering, speaking of the same subject in his report for 1889, said:

"The statements made in my report of last year as to the necessity of increasing the number of officers in the Engineer Corps hold good with even greater force at the present time, owing to the steady decrease of the number of officers in the Corps and the increase in the number of modern high-powered ships soon to be in service, each new one with more auxiliary machinery scattered about in different compartments than its predecessor, and all of which requires intelligent and constant care. The Bureau is constantly embarrassed in finding officers for necessary duty on account of the insufficient numbers in the Corps. The numbers allowed to ships have been reduced as low as prudence will permit, and in some cases even lower than circumstances would seem to justify, owing to the inadequate training and insufficient number of the petty officers, which throws much of the work that should properly be done by them on commissioned officers.

"On shore the officers have to be taken from their regular duty for steam trials and other purposes, with attendant delay in that duty in all cases, and requiring them, on their return, to work long after office hours and on Sundays to keep the current business from falling behind.

"When all the new vessels now appropriated for are in commission it will be impossible to properly officer them in the Engineer Department and carry on the other work of the Corps with the number allowed by law. I therefore renew my recommendation of last year that the number of engineer officers be increased to not

less than 300; and even this number will be found to be insufficient to give the proper care and supervision to the machinery of ships completed and building unless assisted by a sufficient number of intelligent and skilled artificers and well-trained firemen.

"Attention is called to the comparison made in my report of last year between the number of engineers in our Navy and that of Great Britain, and to many recommendations in the report by the Board of Admirals on the British naval maneuvers for 1888 for an increase in the number of engineer officers. If imitations of some of the conditions of war made the insufficiency of numbers apparent, it does not seem wise to wait till war comes to profit by the lesson."

Extract—Report of Engineer in Chief, 1890.—In his report for 1890 that officer recurs to the same subject as follows:

"In my former reports this subject has been dwelt on at some length, as it was deemed one of the most important with which we have to deal. It is with regret that I have now to report that matters are now in still worse condition than they were a year ago, and that troubles mentioned as likely to occur are already apparent, for the number of engineer officers now in the service is not sufficient for the proper performance of the duties required of them. All that I have heretofore said can be repeated with emphasis, but in this report I shall only call attention to a few of my former recommendations in connection with what will now be presented. . . .

"When my last report was published, but one ship (the *Yorktown*) with modern machinery had been commissioned; since then three others (*Baltimore, Charleston,* and *Philadelphia*) have been placed in regular service, each with one to two less engineer officers than they should have for safety and efficiency, and less than they would have if the Corps was sufficiently large to permit the proper detail, but still more than will be possible when the number in the Corps has been reduced to the legal limit of 170. As had been foreseen, the worry and anxiety undergone by these officers in their endeavors to keep things going and in order, with the insufficient number of trained men at their disposal, has proved too much for some of them, and they are breaking down. A policy which leads to such results can only be productive of disaster to the service. It requires a very simple calculation to show that the present legal numbers in the Engineer Corps will not be sufficient to properly officer the ships now in commission and those for whose construction appropriations have already been made, and this without taking into account the number required for shore duty and to provide for sickness and an occasional leave, etc. Something must be done, and done promptly, or we shall not only have some serious breakdown to repair which might have been avoided, but also an accident more than likely to be attended with loss of life. . . .

"In the naval battle of the future the engineer staff will have a difficult and important part to perform, and if there is failure in the engine room no amount of skill and bravery on the bridge may suffice to avert disaster. Celerity of movement has decided many a naval battle and will decide many more, and the celerity of movement of a modern ship depends directly on the skill of her engineer officers."

Extract—Report of Engineer in Chief, 1891.—In his report for 1891 the same officer still further emphasizes the subject. Among other things he says:

"It is with regret that I am again compelled to report that the number of engineer officers is insufficient for the proper performance of the duties belonging to them and to emphasize the fact that unless measures are taken at once to remedy this condition and to stop the steady decrease in numbers, we shall before long have a painful awakening by a serious breakdown or accident on some of our vessels. There is a limit to even a naval engineer's endurance; and while the officers of the Engineer Corps will do their best to make all needed repairs and keep in efficient condition the magnificent machinery of the new vessels, from which the country justly expects so much and in which it takes a proper pride, they can go no further than the limit of their physical strength; when this has been reached the machinery must take care of itself.

"The necessity for an increase of the Engineer Corps is recognized throughout the service, and it was gratifying to find in the annual report of the Navy Department for last year that both the Honorable the Secretary and the Chief of the Bureau of Navigation recommended it. . . .

"Inasmuch as the bill introduced in the last Congress has failed with the close of its sessions, I give herewith the features which I believe should be embodied in any measure for an increase of numbers.

"The number of engineer officers should be at least 300, and even this number will be inadequate unless supplemented by a sufficient number of intelligent and skilled artificers and well-trained firemen. The division into grades should be in accordance with the duty to be performed, and as far as practicable arranged so as to give reasonable promotion in order to keep the ablest young men in the Corps. At present we are constantly losing bright and promising young men by reason of slow promotion and overwork. . . .

"I have given the matter of the necessary number of engineer officers most careful study and consideration, and am prepared to submit, at the proper time, details in regard to the number needed and a scheme for recruiting the Corps. I need not go into this here, as the important point is to secure action by Congress; when this is assured, I can submit a memorandum to the Department for transmission. I may say here, however, that the number of officers asked for is neither a guess nor an approximation, but is a careful estimate based on the actual duty to be performed at sea and on shore; it was made by considering the needs of every ship and every shore station, making allowance for the fact that all our ships will not be in commission at once, and that some provision must be made for sickness and leave. In other words, it is the minimum number which, in my opinion, will be adequate for ordinary circumstances in time of peace; it will be altogether too small in time of war.

"It should be added that the proposed increase should be made gradually, in order to secure thoroughly good men. Twenty each year till the full number is reached would provide for this gradual increase, and still allow for the reduction due to retirements and resignations of some of the younger men, who can not resist the tempting and lucrative positions offered them in various mechanical and electrical engineering establishments and technical schools. Much as we need the full number asked for now, I would regard it a misfortune to have the entire increase occur in one or two years, as it would be impossible to secure the required number of competent men in that time."

For ten successive years these and similar statements have been urged upon the attention of Congress. They have been strikingly reinforced by the number of prostrations of naval engineers, due to overwork, the progressive increase in the cost of repairs to machinery, due to an insufficient number of naval engineers to maintain the necessary supervision, and the lack of a reserve of trained officers.

The undermanning of the Naval Engineer Corps.—The November number of the American Engineer and Railroad Journal, in the course of an able and extended review of the present condition of the Navy, presents figures which throw a striking light upon this point.

At the beginning of the war, in 1861, the Government had 89 ships, of which 37 were propelled by steam. For the entire 89 there were 671 line officers, and for the 37 steamers 174 engineers. In 1864, at the height of the conflict, when the Navy had been placed upon a war footing, there were 2,846 line officers and 1,728 engineers. In 1865 the numbers had been changed to 2,463 line officers and 2,279 engineers. In the following year, 1866, the Navy had been reduced to a peace footing, and there were 395 line officers and 379 engineers. During the next twenty years the number of line officers was steadily increased and the number of engineers as steadily diminished, so that on the 1st of January, 1886, with only 85 vessels on the Navy Register, as against 320 in 1866, there were 733 line officers and only 221 engineers. Ten years later, January 1, 1896, when the new navy had come in with its great steel ships, enormous engines, high-power guns, and complicated machinery, there were 108 vessels on the Navy list with an aggregate of 317,275 horsepower, but the number of engineers had been reduced to 173—one less than just before the war, when there were only 37 steam vessels in commission, not one of which had an engine of more than 1,000 horsepower. As matters now stand, the ratio of engineers to line officers in our Navy is 1 to 4.13, while in the British navy the ratio is 1 to 2.18, and active efforts are there under way to increase the number of engineers on the ground of the inadequacy of the present force.

The consequence of this astonishing condition of things in our Navy is what might be expected. The engineering force on shore is too small to perform the duties properly belonging to it, and the force on shipboard is breaking down under the stress of overwork and anxiety. Chief Engineer Tower, of the *Indiana*, whose case recently attracted public attention, had been on duty continuously for thirty-six hours when he succumbed to the strain. We might cite numerous other special cases, but prefer to quote the statements of two eminent authorities.

Our overworked naval engineers.—A letter published in the Philadelphia Ledger by Dr. Robert H. Thurston, director of the Schools of Mechanical Engineering and of the Mechanic Arts of Cornell University, suggested by a dispatch to that paper on the fatality attending the Engineer Corps of the Navy, in consequence of overwork, calls attention to this condition of things in the most impressive manner. We quote portions of the letter:

"SIBLEY COLLEGE, CORNELL UNIVERSITY,
"Ithaca, N. Y., November 22, 1895.

"SIR: I was intensely interested in and greatly distressed by the communication of November 19, in your Washington correspondence, relating to the condition of the Engineer Corps of the Navy. I was myself a member of that corps during the civil war, and for a half dozen years or more after its close, and many of the men whose suffering and death you describe were acquaintances, some of them personal

friends, and among these were some of the ablest and noblest men that the United States Navy ever knew, and the proportion of noble and able men in the Engineer Corps was always great. I know that the tale is not overdrawn and that much more might be said with full justification. The list of officers thus needlessly destroyed might be greatly extended; for it is not since the new navy has been under construction only that the Engineer Corps has been thus overworked and overstrained. This latter period has only intensified a strain which has existed in a milder form for many years, and the present crisis is but the culmination of a gradually and steadily increasing pressure, which dates from the earliest days of the steam navy.

"During the war men were ready to meet any and all kinds of danger, hardship, and imposition, and resignations were rare, but an exodus began immediately afterwards from the ranks of this corps, which has never wholly ceased. Men have, in many instances, clung to their old employment, and still remain in service, able men, helpful and efficient men, men of talent and culture, who might have done much better in civil life, sometimes through pure sentiment; oftener, I am inclined to think, because sentiment was reenforced by the sanguine expectation—never yet justified by the facts—that justice and wise expediency would in time rescue them from the obviously impending day of unbearable trial. But the service has for a generation past lost continually by resignation, and its losses have included many of its most valuable officers, most of whom might probably have been retained had wisdom and justice and good feeling marked the legislation of Congress and the policy of the executive department of the service. Of those who have thus resigned I have known many, and I do not now recall a single case in which the officer thus returning to civil life was not greatly advantaged, from a business point of view, by the change. If the existing crisis is not promptly and wisely dealt with every other member of the Engineer Corps who can find his opportunity will resign, and hard service and the weight of responsibility now thrown upon everyone on duty, and in rapidly increasing intensity, will pass the rest either over to the retired list or into the other world. The present condition in this department of the United States Navy, at least, is discreditable to the Naval Committees of Congress and to Congress itself, a reflection—less deserved, perhaps no less real, however—upon successive administrations, and especially the latter ones, and upon the responsible heads of the Navy Department of the last generation.

"I have personally known the Engineers in Chief of every Administration, from 1861 to the present time, and I know that every one of them has faithfully represented the condition of the Engineer Corps to the Navy Department and to Congress, so far as they were permitted. . . . The present Engineer in Chief has been more outspoken than many of his predecessors; but even his reports, so far as published, give no adequate idea of the nature or magnitude of the existing crisis. As I write his report lies on my desk, and I observe that he simply states that 'the number of cadets in the Engineer Division now being graduated by the Academy is not sufficient to supply the vacancies in the corps caused by deaths, resignations, and retirements. If some means can not be devised whereby the Engineer Division at the Academy can be increased, recourse must be had to the technical schools and colleges of the country to fill the vacancies, as the number of engineer officers is now less than allowed by law and very much less than the needs of the service require.'

"This statement reads very mildly, coming from Engineer in Chief Melville, and my interpretation of it is that either he has given up in despair of securing a proper and efficient service in the Engineering Department and a creditable Engineer Corps, or his usually outspoken and honest statements and protests against this long-progressing deliberation of the Engineer Corps have been themselves dehabilitated by official pressure. But in any case the responsibility for this fearful injury to the Navy and to the country must lie with the Navy Department and Congress. The possible consequences, aside from the destruction of the corps itself and of so many brave and able men in case of the outbreak of war which so many of our 'statesmen' are predicting, are tremendous—a fine navy ruined and probable failure in every naval contest.

"That responsibility does not, I am sure, lie with the Engineer Corps itself. It is composed of the best men that were ever gotten together in any service, and the most convincing testimony of the bravery, patriotism, and ability of these officers is found in the fact that they still remain in the service and on duty. The fault does not come of neglect on their part to report the necessity of action on the part of the Department and on Congress. The trouble arises from the fact that their recommendations have been entirely unheeded. . . . This matter affects the lives of every engineer officer in the service, of all officers and all men, in fact, for no one can say when a ship may be lost, or a battle fail of success through disability of the engineer department of some heavy iron-clad. It affects the honor and efficiency of the whole Navy, it touches the honor of the nation.

"R. H. THURSTON."

An inadequate Naval Engineer Corps a naval weakness.—The editor of Cassier's Magazine for October, 1896, speaks as follows on the same subject:

"The overwork to which naval engineers are subjected was again evidenced in the eight-day maneuvers, a short time ago, of the North Atlantic squadron of the United States Navy. On the battle ship *Indiana* Chief Engineer Tower and one of his assistants, A. McAllister, collapsed. This represents 50 per cent of her complement of engineer officers. That is to say, the 'endurance' of the battle ship *Indiana*, under easy maneuvers in time of peace, is practically just eight days, as far as her absurdly insufficient engineering complement is concerned. There seems no doubt that, in the event of war, there would be naval collapse under present circumstances. In addition to the officers mentioned, several machinists and a number of firemen were brought up from below prostrated. Within the past few weeks also Chief Engineer Borthwick was recommended for retirement, by reason of injuries incident to active service. This is a pretty sorry record—one that any naval power worthy of the name should be ashamed to have known. The only consolation that the United States has in the matter is the poor one that the British navy is in a similar, but not so hazardous, a plight. One would think that both Governments would promptly take sensible measures, tending to a proper valuation of naval engineers' services, and a decent recognition of the fact that they are all-important to the value of their men-of-war as fighting machines."

Immediate need of increase in Corps of Naval Engineers.—We have dwelt at length on this phase of the subject, partly because the existing situation is of such grave import that the public mind ought to be thoroughly aroused to its dangers, but more especially because the facts stated form the foundation of the whole argument. If the conviction is once established that the engineering force of the Navy is totally insufficient in numbers, the people of the country will demand from Congress prompt and energetic action. The question will then become one of means and methods only.

The bill under consideration, recognizing these acknowledged and threatening evils, proposes an adequate and entirely practical remedy. It proposes to enlarge the Engineer Corps of the Navy by making use of facilities already provided, and provided for the most part at public expense by existing technical institutions throughout the country. It does not in the slightest degree interfere with the course of engineering instruction already given at the Annapolis Naval Academy; but it proposes, after all Annapolis graduates have been assigned, to call upon the civilian institutions named to furnish from among their graduates a sufficient number of trained men to make the required increase—extending this increase progressively over a series of years.

The bill provides for increasing the active list of the Engineer Corps of the Navy from the present number, 191, to 303. Until this number has been reached, 30 engineer cadets are to be appointed each year, in addition to the number of vacancies occurring in the Engineer Corps during the preceding year, and after the full number has been reached the number of cadet appointments each year is to be double the number of vacancies occurring in the lowest grade of commissioned engineer officers during the preceding year.

Educational feature of the bill.—Graduates of technical schools whose course of instruction in mechanical engineering is considered satisfactory by the head of the naval engineering service and the Secretary of the Navy are eligible for appointment as engineer cadets. Candidates must not be less than 19 nor more than 24 years of age, and before appointment must undergo a physical examination before a board of medical officers of the Navy. Those who receive appointments are to be given one year of practical naval engineering instruction on board a vessel of war, and a second year of practical and theoretical instruction in a navy-yard or at some advanced professional Government school for graduate work. At the conclusion of this two years' service they are to undergo another physical examination and a professional examination at the Naval Academy, and the order of merit shown by the latter examination determines the order of appointment to vacancies in the corps of engineer officers.

Those who fail to secure commissions in the naval service, but who have satisfactorily passed the required examinations during the two years of probationary service and instruction, are each to receive an honorable discharge, and the sea pay ($1,200) of an ensign in the Navy. The Government recognizes the fact that those who fail to receive commissions are entitled to consideration. These young men will have received a training which will make them valuable members of the naval reserve; and to compensate them for giving two years of their life to the acquisition of naval instruction, they are to be given the pay which is now received by the Naval Academy graduates who fail to enter the service.

It will be seen that the provisions of the bill thus far mentioned aim on the one hand to provide the needed increase of naval engineer officers, and, on the other hand, as regards the technical institutions concerned, to open an additional career for their graduates. Other provisions affect the actual work of the institutions more

directly, and contain the promise of benefits which the great majority of them could not secure in any other way. For example:

Benefits accruing to educational institutions and to naval service.—(1) Facilities for instruction in naval and marine engineering and naval architecture are to be furnished by the loan of such models, plans and machinery as can be spared without detriment to the naval service, many of which would be of great value either as working equipment or as illustrative material in shops and laboratories and museums.

(2) Professional naval engineering literature, in the form of monographs and similar publications of the Department of the Navy, is to be furnished free of cost to such students as pursue the prescribed course of engineering studies.

(3) It is proposed to detail officers of the Corps of Naval Engineers as professors of engineering at such institutions as maintain these courses of instruction. These officers will give practical and theoretical instruction in the technical subjects relating to their profession, in cooperation with the regular teaching staff, and with a view to supplementing their work in the engineering courses.

(4) Provision is made for an efficient and thorough inspection of the instruction in naval engineering given in the institutions to which commissioned officers are detailed. It is not probable that such inspection could extend to the minute details of the work, and it is doubtful whether it would be desirable that it should; but the steadying and stimulating influence of a competent official inspection at suitable intervals could not fail to be constantly felt by instructors and students alike, as is now the case with the somewhat similar inspection exercised by the War Department over the work of the military officers detailed to the several institutions.

(5) The advantage to the naval service of having able officers detailed to colleges throughout the country can not be overestimated. Their influence and example would be a powerful stimulus to the department in which they were employed; while in turn they would receive the broadening inspiration which comes from contact with scholarly men engaged in different departments of knowledge.

National scope of the measure.—The far-reaching importance of this measure, the educational features of which have been thus briefly outlined, can hardly be overestimated. It touches alike great questions of public policy and special questions of technical training. The indispensable necessity of providing a greatly increased force of thoroughly trained engineers to meet the requirements of an enlarged Navy must, in view of the evidence presented, be fully and promptly recognized. It is a simple matter of fact, which no one disputes, that the existing courses of instruction at the Naval Academy do not meet this imperative demand, nor can the Academy be made to do so without such important changes in legislation and administration as are not likely to be undertaken until some Secretary of the Navy, informed with the spirit of the new era and opening his eyes to a vision of the twentieth century, shall grasp the changed condition and the new needs of the modern navy with the same comprehensive intelligence which George Bancroft in 1846 brought to bear upon the conditions and needs of the old navy when, as Secretary, he established the Naval Academy and thus radically reorganized the entire system of training naval officers. The time for a like reconstruction has now come. New terms demand new measures as well as new men. The new navy has become an engineering service and its organization must accordingly make distinct recognition of that fact.

Excessive cost of educating cadets at Naval Academy —Even if it were practicable to modify the courses of instruction at the Naval Academy so as to provide in due time the requisite number of engineer officers, such a policy would, in the opinion of your committee, be neither desirable nor economical.

Under the present system it costs the Government of the United States from $12,000 to $15,000 to graduate a cadet at Annapolis, while the entire increase contemplated by the bill under consideration could be provided by existing technical institutions without the expenditure by the Government of a single dollar beyond what must in any case be expended in order to maintain the Engineer Corps at the point of average efficiency on a peace footing. Stated in another form, at the present rate of educating naval officers, it would cost the Government a large amount to graduate at the Naval Academy the 30 cadets which it is estimated should be annually added to the corps until the full number is reached. If half of this number should be taken from other institutions, as proposed in this bill, the saving to the Government would be very great. The same rate of saving to the Government would afterwards continue, the aggregate amount each year depending upon the number of cadets needed to fill vacancies.

The study of the mechanic arts and sciences would be encouraged.—But the argument on the ground of economy, however convincing it may be, is far less weighty than the considerations of public policy involved. The Government of the United States, on its own initiative, in cooperation with the several State governments, has established and is maintaining a great group of institutions of higher learning, which have already done and are still doing a work of inestimable importance and magnitude in advancing the spirit and improving the methods of scientific research and instruction

throughout the country. These institutions possess property amounting in the aggregate to nearly or quite $20,000,000, with an annual income of $6,000,000, a teaching force of more than 1,600, and a body of students numbering about 18,000, who largely represent that great middle class which forms the bone and sinew and brain of the Commonwealths to which they belong.

The leading object of these institutions, according to the terms of the Congressional charter, is "without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts." The Government has made generous and special provision for extending and strengthening the agricultural side of the work of these institutions, and has supplemented the requirement that they shall teach military tactics by providing arms and equipment and detailing officers from the Regular Army for the purpose of military instruction. But thus far nothing has been done to provide special facilities for instruction or incentives to advancement in the other great department contemplated by the law of 1862, viz, "the branches of learning related to the mechanic arts." The tendencies of modern industrial development have, however, compelled attention in that direction, and it is probable that during the last twenty-five years more of the thought of the educational and industrial world has been turned to that branch of subjects, and more money expended in promoting them, than in any other single direction. Under this powerful impulse every important institution of higher learning in the United States has been forced to extend its work in the mathematical and physical, even more than in the natural sciences, while many new institutions have been established, either as technical schools or manual training schools, devoted wholly or very largely to this field of work. Thus, by enlarging the curriculum of the old institutions, and by the establishment of new ones, the sciences which lie at the foundation of engineering (a word which may be taken to sum up and express the whole matter) have received an enormous impulse. Nowhere is this fact more conspicuous than in the case of the land-grant colleges. When provision was first made for these institutions, the caprice or indolence of an indexing clerk labeled them as "agricultural." Common convenience and a tacit response to popular sentiment for a time perpetuated the label and well-nigh obscured the fact that the original law of Congress contemplated a much broader purpose.

Scope and purpose of land-grant colleges.—But events have proved weightier than words. A growing public need has compelled these institutions, with one or two apparent exceptions, to increase the range and improve the quality of their engineering work, and State legislatures, acting in close touch with the same popular demand, have, as a rule, been more willing to make liberal appropriations for that purpose than for any other. The result is that a vast amount of instruction in all the leading branches of engineering is now being given in all parts of the United States, much of it being of an extent and quality not surpassed anywhere in the world. These land-grant colleges and universities are, in the fullest sense, public institutions, endowed and maintained at public expense, on grounds of a wise and far-reaching public policy. The Wilson-Squire bill proposes to make use of the facilities thus already provided at public expense as a means of recruiting one arm of the public service. It proposes for the first time in the history of the country to place the graduates of these institutions upon an equal footing with the graduates of the Naval Academy, and the reaction of such a policy upon the institutions and upon the Naval Academy, as well as upon the entire naval service, could not fail to be powerful and beneficial.

Advantages to be derived by the Naval Academy and the naval service.—We do not propose in this report to pass the slightest criticism upon the system of instruction pursued at the Naval Academy, though the single year devoted to marine engineering is obviously and even ridiculously inadequate. But to any educational institution nothing is more fatal than isolation from the life of other institutions. However strong in its faculty, its equipment, and its financial support, it can not do its best educational work or keep pace with the progress of its own time without the stimulus of competition with others engaged in the same field of activity. Fixed methods tend to become routine, routine hardens into rigid mechanism, and mechanism would become petrifaction unless it were saved by the perennial vitality of knowledge itself. At present the Naval Academy stands alone. Its graduates compare themselves with one another. Its standards are their standards, its methods their methods, its range of work their range. But the passage of this bill would promptly change all that. The graduates of the Academy would at once be brought into competition with the choicest men from other institutions, and the competition would test not merely the capacity to stand a fixed theoretical examination, but the habit of mind, the grasp of principles, the breadth of view, the adaptability, the readiness of resources, the staying quality of the men who had been trained under the different systems. This test of the men would be even more surely a test of the institutions themselves, and thus the existence of a high standard, of absolutely uniform application in all parts of the country, would have an immense uplifting and vital-

izing potency. The civilian institutions would learn from the Academy and the Academy from them. If either failed to stand the test successfully, both public opinion and the necessities of the public service would compel the finding of a remedy.

Duty of the nation to these institutions.—These and like considerations would apply, if the only question were how to secure the needed increase of naval engineers at the least expense and of the highest efficiency. But it should not be forgotten that as to a large number of the technical institutions of the country (the land-grant colleges and universities represented in this Association) the National Government is in a peculiar sense responsible, and that any measure calculated to widen their field of usefulness not only serves the better to fulfill the original intent of Congress but closely touches the honorable repute of the Government itself. Having established these institutions, it should adopt such a policy toward them as will maintain them at the highest point of efficiency and secure from them to the public service the largest possible return. No one can doubt, for example, that the cause of good order is promoted and the national defense strengthened by the fact that they are, year by year, sending out into the community a very considerable number of young men trained in a knowledge of the elements of military science and practice, better informed as to the place the military service occupies under our system of institutions, and prepared in case of need to render intelligent and effective service to the Government. In the same way these colleges, without a cent of additional expense to the Government, but by the simple adoption of some such measure as the bill referred to, may be made to contribute to the naval establishment a body of technical skill and training which could not otherwise be secured, except by an immense annual expenditure. It is even doubtful whether it could be so effectively secured by any expenditure, however great, applied to other institutions or agencies, as it can through institutions distributed throughout the country as these are, and holding their peculiar relation to the life of the people.

The naval service strengthened by bringing the Naval Academy into competition with other scientific institutions.—It is a matter of common remark that the training to which our present naval officers are subjected and the course of life which they necessarily pursue tend to separate them in occupation and in habit of mind, more than any other branch of the public service, from the thoughts and feelings and interests of the great mass of the people. Under our system of institutions no class of public officials, no branch of the public service, no body of men whatsoever, ought to be thus comparatively shut out from contact and sympathy with the common life. In this respect it would be of incalculable service to the Navy if its professional ranks were constantly being recruited from among the graduates of civilian institutions who, at their age, would necessarily carry into the naval service more of the civilian habit of mind and manner of viewing things, and would compel the members of the regular naval corps to compete, not among themselves exclusively, but with picked men representing the best training of the country at large. The fact of the naval service being thus recruited would also create a much more general and intelligent interest in it throughout the country at large, and would help to educate the people to look upon it more directly as one of their own agencies. It seems unquestionable that this mutual reaction of the nation upon the service and the service upon the nation would result in great advantage to both.

A naval engineering reserve secured by passage of this bill.—Nor would the advantage be measured exclusively by the number of students from civilian institutions who should actually enter the naval service. But a large number still, who would probably for various reasons never enter the service except in case of an emergency, would yet carry with them into their civilian employments a knowledge of and interest in the technical requirements of the Navy, which would furnish a body of trained, sympathetic, and intelligent criticism that would serve as a wholesome tonic to the service; and, more than all, they would furnish an invaluable naval reserve which the country might summon to its defense in time of war.

The national need of a naval engineering experiment station.—At the risk of extending this report beyond convenient length, we must briefly notice two other features of the Wilson-Squire bill—that providing for an engineering experiment station and that relating to the organization of the Engineer Corps. Of the former little need be said before such a body as this. The quickening impulse that has been given to every branch of agricultural science and practice by the establishment of experiment stations in the United States and in Europe clearly indicates what may be done by such agencies. The station carries on systematically and continuously, on a scale of broad cooperation, what the individual in most cases can do only in a fragmentary and isolated way. A similar means of research and experiment in relation to the numerous and difficult engineering problems that are constantly arising could not fail, as it seems to us, to be of great and lasting benefit to the naval service itself and to every branch of the limitless field of physical research. It is wise, doubtless, to confine the work of the station, at the outset, to the special needs of

the Navy; but the results obtained there must very soon become common property, to the benefit of the entire industrial system of the country. The proved utility of the work would almost of necessity lead to its extension in many new directions, and, if the spirit and purpose of this bill prevail, the whole system would most naturally become correlated to and cooperative with the same branches of work in the approved technical institutions of the country.

The graduates of technological schools will demand an unqualified military status.—As to the legal organization of the Engineer Corps of the Navy this committee has not felt that it could wisely undertake to form an opinion respecting a question so much outside of the range of its immediate concern. It has preferred to devote attention to those educational features of the bill upon which the members of this Association have a right to form and express an opinion, and the committee believed that, in so doing, it would best subserve the interests of the naval service and of the institutions here represented. There are, however, one or two points involved in the pending bill which are quite pertinent to the considerations presented in the preceding part of this report. It strikes the uninstructed layman as a very peculiar condition of things which not only diminishes the necessary expert force of skilled engineers far below the point of actual safety, but so far fails to recognize changed conditions as to relegate that force to a position of military inferiority. A recent editorial in the London Engineer, discussing this general subject with reference to the needs of the British Navy, says: "The truth will have to be recognized that without the engineer, the admiral, the captain, the blue-jacket, the whole executive branch of the service are useless. The naval supremacy of Great Britain rests in the hands of the engineers."

Value of the machines of naval vessels.—Since the year 1889 the United States Government has made contracts for the construction of hulls and engines of naval vessels which, including premiums paid, amount to more than forty-five millions of dollars. This is in addition to the amount expended in the construction of vessels in the Government navy-yards, as well as for armor and armament of all the vessels. The machinery of the new battleships is estimated to cost at least 40 per cent of the entire cost of hull and motive power, that of the fast protected cruiser over 50 per cent, and that of the torpedo-boat destroyer 66 per cent. This is exclusive of the armor and armament.

Importance of giving an unqualified official status to the engineer officer.—The modern war ship is, in fact, a great fighting machine, the construction, maintenance, and handling of which demand the highest skill and training. The graduates of our technical institutions who are fit for the performance of such duties are everywhere in demand in the higher walks of all the engineering professions, where they are accustomed to receive the consideration and pay to which their attainments entitle them. It need hardly be said that such men will not be attracted to the engineering service of the Government unless they find in that service the same conditions prevailing. It is accordingly an essential part of the scheme for inviting the graduates of technical institutions to enter that service that they shall there receive the rank which is required by the nature of their duties. We can not better state the nature of these duties, as illustrating the real status of the engineer in the modern navy, than in the words of Professor Hollis, of Harvard University, who was formerly an officer in the service:

"The duties performed on shore by the engineer consist of the design and inspection of the propelling machinery and boilers, and of certain auxiliary machines for all our ships; of the care of navy-yard machinery under the control of the Bureau of Steam Engineering, and the inspection of boilers; of the superintendence and inspection of all repairs to machinery; of all the routine duties incident to examination of men for employment or enlistment in the engine departments; and to the examination of officers for promotion, and of the inspection of certain materials for use in the naval service.

"The duties of the engineer at sea consist of the care of propelling machinery and of most of the auxiliary machinery; of the repairs to all machinery; of keeping watches in all except the smaller vessels, and superintending the running of machinery; of looking after the storage and expenditure of coal and stores; of keeping that part of the double bottom and inner skin of the ship beneath the machinery and boilers properly cleaned and painted; of looking after the efficiency of all pumps; of keeping in good condition all water-tight doors in the machinery and boiler compartments; of making all official reports and requisitions under the cognizance of the Bureau of Steam Engineering; of maintaining a division of from 20 to 196 men in a state of organization and efficiency, the number of men depending upon the size of the ship; also of requiring and inspecting the clothing for these men; and of other duties, such as court-martial, official inspections, ship visiting, and examination of provisions and stores which all officers, line and staff alike, have to share."

It is obvious that the engineer's service is the vital point of safety both for the ship and for the lives of its crew. A failure here might easily involve appalling disaster in time of peace and national humiliation in time of war.

Work accomplished by the Association.—In furtherance of the duty intrusted to it, the committee has labored to present and urge these views as fully and widely as possible. An extensive correspondence was carried on within and beyond the membership of this Association, and the response was in nearly every instance most cordial and helpful. The committee desires in this public manner to express its hearty appreciation of the intelligent and earnest efforts put forth in so many quarters. Some institutions enlisted not only their faculties, but their boards of trustees, their alumni, and their students. Engineering societies, newspapers, and magazines have given a vigorous and effective support to the measure, and we have good reason to believe that a continuance of the same activity will result, at no distant day, in the enactment of a law embracing all the important features of the present bill.

GEO. W. ATHERTON,
JAMES H. SMART,
HENRY C. WHITE,
Committee.

Mr. HARRIS. I move that the report be accepted and that the committee be continued under the original instructions.

Carried.

The CHAIRMAN. We will now take up the amendment to the constitution, relating to membership, proposed by H. P. Armsby, of Pennsylvania, as follows: "No delegate shall vote in more than one section and each delegate shall, when presenting his credentials, designate the section in which he desires to vote."

It was voted that this question be indefinitely postponed.

The CHAIRMAN. The president's annual address is now in order, and President S. W. Johnson will address the Association.

ANNUAL ADDRESS BY THE PRESIDENT.

GENTLEMEN: I shall occupy your valuable time for but a few moments on this occasion. You are specially concerned in two great branches of worthy endeavor, viz, the promotion of agriculture and experiment and the education of those who are or are to be engaged in the practice of agriculture, mechanic arts, commerce, and domestic affairs.

You represent 54 agricultural experiment stations to which are attached 33 substations wherein 586 persons are working with head and hand in the business of discovery. You also represent 57 agricultural colleges that employ over 1,300 teachers and officers in giving instruction to 14,000 pupils, young or old, in industrial science and practice. In support of these grand enterprises you have the good will and substantial aid of our United States in their legislative and executive capacities, and in most cases liberal appropriations from the governments of the several States.

You have the intelligent appreciation and hearty cooperation of all good citizens who have been able to thoroughly inform themselves as to the objects and methods of your work.

Our country has become noted for the endowment of many schools, colleges, and even universities by men whose thrift, enterprise, and good fortune have enabled them to amass wealth. Some of the colleges represented in this association have been thus essentially aided by private munificence.

We have also evidence that the agricultural experiment stations are finding similar appreciation. A citizen of Connecticut, who during his lifetime manifested a lively interest in the work of the station with which I am identified, has bequeathed a very considerable estate to the board of control of that station, providing that presently one-half of the income and ultimately the entire income therefrom shall be applied to carrying on the work of that station in accordance with the legislative enactments under which that work has been prosecuted hitherto.

The forty years that have elapsed since I began to teach agricultural science have witnessed a most wonderful development in general and technical education. The school in which I commenced my life work in the year 1855—one of the first to establish and I believe one of the very few to maintain courses of agricultural instruction without a break for forty years—had when I took a place in its faculty but two working professors and the same number of assistants. It had but 25 or 30 students; its total yearly income was about $3,000; its entire endowment yielded but $300 annually, and that source of income was cut off after a few years.

Now that school has a corps of teachers larger than our greatest universities had when it began its career, its annual pay roll exceeds $100,000, and some 550 or more students are in daily attendance. Forty-five years ago, when I was in that school as a student, no examinations were required on entrance, and no honors were awarded

on departure. Now, with very few exceptions, its students are candidates for degrees, and sustain an entrance examination which of itself is almost a liberal education.

The last twenty years have seen a no less remarkable development of the agricultural experiment station. Here Connecticut was again among the pioneers, and she then harbored within her borders some dreamers of a good time coming when industrial practice and science should voluntarily yoke themselves together and harmoniously pull together for the common good. But that in so short a space as twenty years every State and every Territory that was and that was to be within that time should have one or more effective experiment stations in full operation, entered not into he heart of any man to conceive.

In 1853 I had the good fortune, as a student, to matriculate in the University of Leipsic. I soon found my way to Möckern, a neighboring village, where had been very recently established the earliest agricultural experiment station, founded on a farm, by an association of farmers for the exclusive purpose of applying the methods of scientific research to elucidating urgent questions of farm practice. Since that time I have had occasion to become somewhat familiar with the work of most of the European agricultural experiment stations, and I am proud to be able to say, I believe truthfully, that the experiment stations of these United States are, on the whole, not less efficient and not less useful than those of the Old World. We have not made such brilliant discoveries or carried out such extensive fundamental investigations as are associated with the names of Wolff, Julius Kühn, Gustav Kühn, Henneberg, Stohmann, Hellriegel, Nobbe, and Wollny, but we have made a good beginning, and have laid some foundations, broad, deep, and permanent, on which fair superstructures are surely building, which it is admissible to hope will favorably compare with the results of the efforts of our European colleagues, who were earlier in the field and have had twice or thrice the time, or even more, for bringing their work to fruition that any of us have enjoyed.

In both college work and station work we have to adapt our efforts to the needs of those who are to be immediately benefited. Neither college nor station can secure the support of citizens who are unable to appreciate what we are doing. Our duty is to aim as high as possible without overshooting the mark. We can not succeed with instruction that is too purely disciplinary, because our constituents will not relish it; neither will success be attained by the cramming process. The young pupil and the parent must both be brought to see that profitable education demands first of all enlargement of mental capacity as an essential prerequisite to extensive acquisitions of knowledge, and that if a man is well exercised and developed in all-round intellectual athletics his appetite, his digestive and assimilatory powers may be fully trusted to find abundant nourishment and to make rapid and healthy growth.

Unfortunately, we have too many rather bright but small, smoothbore citizens, who can not perceive that they are not great guns, and who are ready on the briefest notice to undertake the world's work, which they hasten to do by disparaging, undermining, and leveling down whatever is above their power to surmount or to understand. The pernicious activity of these undisciplined superficial people tends to bring it to pass that schools, colleges, and, if possible, experiment stations are organized and operated on a low plane by men who impose on the public with large talk about little things, to the disgust and humiliation of the true friend of progress.

But such drawbacks will not permanently block the wheels. You can not get together twenty or thirty young men or young women and begin to educate them on ever so narrow and elementary a basis that they, or the best of them, will not sooner or later acquire that unquenchable thirst for knowledge and that activity of mind which surely impel to wider and higher culture.

In my own State the Sheffield School of Yale University has been definitely pronounced unsuited for agricultural and mechanic-art education, because it requires an elementary knowledge of Latin for admission to its regular courses. But now we are told that the students of the Storrs Agricultural College who have entered that institution without further preparation than the common school can furnish, and who may have a preliminary year in the college itself to make up deficiencies in preliminary studies—we are told, I say, that these young men and young women desire to study Latin, having found that there is great use for some acquaintance with this immortal dead language, and having come to perceive that those who know Latin are far better judges of its utility than those who do not.

In agricultural and industrial education much good use may easily be made of both Latin and Greek, because they are so universally taught in our preparatory schools and academies, because they furnish excellent mental discipline, and for the important reason that some knowledge of them vastly facilitates the handling of the English tongue, the mastery of science, nomenclature, and the acquisition of a working use of French and German scientific literatures, those vast storehouses of things new and old, inability to employ which is a heavy handicap to the investigator in every department of inquiry.

But for the tens who can devote the time needful for a really liberal education

there are thousands that must be content with a smaller intellectual equipment, and to them it is a great boon that we have in every State and Territory of the Union a school, college, or university where they can obtain cheaply the means of self-development in many noble directions, and of instruction in many useful sciences and arts; and if but few can make present avail of the full three or four years' curriculum, yet in some of the shorter, more technical courses which are now so generally and generously offered the earnest inquirer may find opportunity to enter on the highway of science. And here I may perhaps be pardoned for expessing my personal satisfaction in the recent successes of the shorter course. The vain efforts of my teaching colleagues and myself thirty years ago to secure attendance of more than a very few young farmers on our longer courses of agricultural instruction led us to plan and announce a shorter course to fully occupy and to be completed in six weeks of the winter time, and for years Professor Brewer and I held ourselves ready to do extra work in behalf of any who might enter for such a course. But we were up before the daybreak, and the generation then on the stage had to pass and make room for another before either the longer or the shorter course was to be in demand in the State of Connecticut.

It is something, however, to have been forerunners, even though seemingly we were but as "a voice in the wilderness," for the wilderness is breaking into bloom.

The skillful teacher will know how to make the study of any subject and the practice of any art wholesome as a discipline, as well as satisfying and inspiring to the awakened intellect. For this purpose the teacher should evermore remain an earnest student, keeping as far as possible abreast with the advance of knowledge in the subjects he teaches, and if he can also take active part in research his influence will be the more powerful and pervading.

Just as in our colleges of agriculture and mechanic arts, we should be careful at the outset to fit discipline and instruction to the actual needs of the students. So in the experiment station we ought at first to give prominence to those lines of work which our constituencies can most plainly see are to them directly useful—are, in fact, to them indispensable. The first and firmest hold which the station has had on the people of the Eastern and Southern States has been its demonstrated ability to make the farmer safe in the purchase and intelligent in the use of commercial fertilizers. Another stout link between practice and science has been that series of developments which are vividly called to mind by mention of the "Babcock test."

When the men of practice find that they can safely confide in and rely on the men of science in respect both to what the latter claim they can do and admit they can not do, then the men of science are warranted in entering upon the wide field of abstract research; then they are indeed blameworthy if they fail to give a share of their best endeavor to winning for the domain of science some portion of the vast outlying realm of darkness unexplored. For some of us that duty is already knocking at our doors; for all of us the time is short during which we can justifiably neglect to kindle and to tend and direct the search lights of truth.

An immense advantage enjoyed by the German investigator consists in the fact that he has a clientele of landed proprietors who have themselves passed the strenuous discipline of the gymnasium and the university, and have also, so to speak, inherited liberal culture from ancestors highly educated both in the theory and the practice of field and crop culture, and in all branches of husbandry and rural technology.

Thus it was that the Saxon Society of Landholders, which founded the station at Möckern, secured at the outset a brilliant young scientist, Dr. Wolff, and an experienced farm manager, Mr. Behr, to initiate the work of that station. These men were supplied with competent assistants, and they at once began investigations of plant nutrition and of animal nutrition, without any special reference to immediate results, and the work thus laid out on broad lines has been almost steadily prosecuted in that station to this day, and will doubtless go on for years to come, or until a satisfactory conclusion has been reached.

Let us hope that ere long in this country, as in the Old World, the stations will be empowered to put the capable investigators into positions where they can give their powers unreservedly and exclusively to discovery. I have found great satisfaction in following from day to day during the last six or seven years the steady progress which Dr. Osborne's often baffled but always renewed efforts have accomplished in bringing order and illumination into the chaos of plant proteids.

A clear knowledge of the various individual proteids—their composition, properties, physical and chemical, and the means of distinguishing and identifying them—is evidently of the most fundamental importance. Osborne's work has demonstrated that scarce a single one of this class of bodies had been obtained by earlier investigators in a state of purity or had been analyzed with correct results. He has shown that various names long current in proteid literature were applied to indefinite mixtures or to supposed substances that do not exist. He has also made evident that under the names "conglutin" and "vitellin" no less than six distinct proteid substances have been confounded together. So soon as the proteid of our important feeding

stuffs have been chemically differentiated and defined, it will be in order to attack the problems of their chemical constitution by the methods of research that have been applied with such brilliant success in the modern study of organic chemistry.

Until the work thus outlined has been carried far toward a satisfactory finish, the precise nutritive value of the proteids will remain an irresolvable problem.

In respect to the carbohydrates, including the pentosans and pentoses, recent developments of the most signal importance have been attained, mainly through the genius and persistence of Emil Fischer. Here, too, much remains to be learned. What do we know of the nature of the various vegetables used and valued as food for man and beast? The cabbage, the pumpkin, the onion, the apple, pear, orange, grape, all invite the beginning of investigation, while wood, straw, hay, and all common forms of forage, together with the sugar beet and the turnip, are subjects whose study has gone just far enough to display the meagerness of our knowledge of them. It is to be hoped that those chemists among us who have worked with Tollens in this field may find opportunity to cultivate it further.

And here I would urge the younger scientists of our colleges and stations to place themselves, if for but a few months only, under the influence of the great European teachers, and I hold it to be a most worthy use of any funds that may be available to send college teachers and station workers abroad to gather inspiration and finish at the Old World shrines of science. Considered as mere tools, our chemists, botanists, and all who adopt college and station duty as life work are worth sending to be sharpened, adjusted, and polished where that business has been transacted longest and most efficiently.

In closing I will briefly call attention to some matters connected with the publications of our stations which, to my mind, admit of betterment.

As a station director, I hold it to be extremely important that the library of my station and my own private library, which is necessarily distant from the station, should contain complete files of all the publications of all the stations, so arranged that any of them may be instantly referred to.

For this purpose it is essential that a uniform system of publication be adopted and strictly followed by all the stations. The plan most in use is to issue the two kinds of printed matter that are named in the acts establishing the stations, viz, bulletins and annual reports. I am of the opinion that it is a mistake to put forth other styles of publications for two reasons—(1) the annual report and the bulletins are sufficient in number and in kind to include everything that it is desirable to print, and (2) to issue circulars, extras, or what not is to make an unnecessary complication, which has no terrors for the one director who prepares and prints them, but which may be the last back-breaking straws on the shoulders of the other directors, who have to spend many weary hours in trying to keep the run of the hundreds of station documents that are yearly issued.

I would respectfully suggest that simplicity is much easier and much more satisfactory than complexity, which, in case of station documents, always tends to perplexity.

Another matter of importance tending to the longevity of station directors and librarians is that bulletins should be perfectly distinguished and identified by two simple earmarks, viz, the name, in the first place, of the station from which they proceed, and, second, by consecutive numbering, using whole numbers only.

If I have in hand Bulletin 45, then I ought to be able to know that 44, 43, and all the lesser numbers have been not only planned or written, but have been printed and distributed. If after receiving 45 I get 45*a* and 45*d*, I can infer that 45*b* and 45*c* have been issued, but I have no basis on which I can estimate how many of the letters of the alphabet are likely to stand for separate bulletins, and I must write a letter in order to get my bearings, or else the publishing station must take the trouble to print and send out a key to its cipher.

Again, a technical bulletin, or a second or a new series, or Bulletin A, B, C, now and then appears to break the continuity of an otherwise orderly sequence. These sports and freaks are out of the line of natural evolution and their survival should be frowned upon as not of the fittest, but as unmistakable misfits.

I desire to express the earnest wish that each station shall, if possible, maintain a small reserve of publications, the first demand upon which shall be to make good the wants of the sister stations.

Gentlemen of the Association, I thank you most heartily for the honor of presiding over your deliberations at this meeting, and for your appreciative attention on this occasion.

Adjourned to meet at 9 o'clock Wednesday morning.

Morning Session, Wednesday, November 11, 1896.

The convention was called to order by President S. W. Johnson at 9 o'clock a. m.

The Chairman. I have to announce that the members of the committee on military will be G. W. Atherton, A. Q. Holladay, and H. H. Goodell. General business is now in order.

Mr. Goodell. I am instructed by the executive committee to report back the resolution of Mr. Wheeler (see p. 31) in following modified form, and move its adoption:

Resolved, That it is the sense of this Association that station workers in quoting others should give them credit therefor and make such citations as will facilitate ready reference.

Adopted.

Mr. Goodell. I am instructed to report back the following resolution of Mr. Wheeler, with the recommendation that it is inexpedient to take action at the present time:

Whereas owing to a lack of indexing, or to any uniform system of indexing the station publications, much difficulty is encountered on the part of those who wish to consult them, especially where the card index of the Office of Experiment Stations is not available, and to encourage farmers and others in the several States to preserve, bind, and keep them for reference: Therefore be it

Resolved, That this Association recommends that the publications of each station for the year be paged consecutively, and that there be appended to the annual report, or final publication for the year, a title page and an alphabetical index of subjects similar to that in the Experiment Station Record.

The executive committee have considered this matter and have found such obstacles in the way that they think it inexpedient to take action at the present time. It was found that in a number of States the bulletins were published by the stations, while the annual report was published by the State printer, and therefore it was difficult to page them consecutively. In addition to this, it was found that an index to the bulletins would not be allowed with the annual report if published by the State printer. For these reasons the executive committee report that it is inexpedient to take action at this time.

Mr. Atherton. I move that the executive committee be instructed, either directly or indirectly, by reference to the proper standing committee to give the subject as full consideration as possible during the present year, to the end that some convenient system may be adopted, and that report may be made at the next annual convention.

Carried.

Mr. Goodell. I am instructed by the executive committee to report back the resolution of Mr. Harris, in a modified form, and move its adoption:

Resolved, That a committee of three college presidents be appointed by the chair to wait on the Commissioner of Education and request the compilation of a table of statistics, similar to the one prepared by President Atherton several years since, and that if it prove impossible to obtain prompt publication of the statistics by the Bureau of Education, the committee be authorized to prepare and publish statistics at the earliest date practicable.

Adopted. (For committee, see p. 52.)

Mr. Goodell. I am instructed by the executive committee to move the adoption of the following resolution:

Resolved, That hereafter committees shall not incur any expense whatsoever without the specific authority of the executive committee first previously obtained.

Adopted.

Mr. Goodell. There was referred to the executive committee a recommendation that a standing committe of five be appointed on nomenclature. The executive committee recommend the adoption of this recommendation.

Adopted. (For committee, see p. 63.)

Mr. GOODELL. The following memorial presented by Mr. G. McCarthy was referred to the executive committee, and inasmuch as it was not read last night I will read it now. It is signed by thirty-seven directors of experiment stations, and is as follows:

The undersigned directors of American experiment stations, recognizing the benefit to be derived to agriculture from an improvement in the quality of seed merchandise and by enabling seedsmen to offer a guaranty of specified quality, request the Association to appoint a committee of experts in seed testing to devise and adopt a standard form of seed-testing apparatus and method of procedure for use in all American stations who shall hereafter publish seed tests, to the end that all such work shall be strictly comparable and that seedsmen may guarantee the quality of their seeds according to the official method.

We suggest that the committee so appointed shall meet in Washington as soon as possible after the adjournment of the Association, and shall adopt a standard method and form of apparatus, and, further, shall report the same to the Director of the Office of Experiment Stations of the United States Department of Agriculture, who shall be requested to officially publish the same. After such publication, no change in method or apparatus shall be permissible until the same has been approved and adopted at a regular meeting of the Association or by a committee newly appointed, and so on from year to year.

That the Director of the Office of Experiment Stations shall be requested to contract with some responsible instrument maker to furnish, at a reasonable price, the official form of apparatus and accessories to all who may desire the same at their own cost.

We suggest, further, that the Secretary of Agriculture be requested to defray the actual and necessary expenses of the members of the committee while so engaged, out of any funds of the Department available for the purpose. If this is impracticable, the expenses of each member of the committee will be met by the institution which he represents.

The executive committee report back the memorial of Professor McCarthy in the following modified form, and recommend its adoption:

The undersigned directors of American experiment stations, recognizing the benefit to be derived to agriculture from an improvement in the quality of seed merchandise and by enabling seedsmen to offer a guaranty of specified quality, request the Association to appoint a committee of experts in seed testing to devise and adopt a standard form of seed-testing apparatus and methods of procedure for use in all American stations which shall hereafter publish seed tests, to the end that all such work shall be strictly comparable, and that seedsmen may guarantee the quality of their seeds according to the official methods, said committee to report at the next annual convention.

Carried. (For committee see p. 63.)

Mr. SMART. I move that the president of the Association appoint a nominating committee of nine to report to the Association a list of candidates for the offices to be filled.

Carried. (For committee see p. 56.)

Mr. ATHERTON. I move that the Association give unanimous consent that Professor Hamilton, deputy secretary of agriculture of Pennsylvania, be allowed to address the Association at this time.

The CHAIRMAN. There being no objection Professor Hamilton has the floor.

ADDRESS BY PROF. JOHN HAMILTON OF PENNSYLVANIA, ON AGRICULTURAL EDUCATION.

I have asked for the privilege of the floor this morning that I may have the opportunity of calling your attention to a feature of the work of education, in the direction of practical and scientific agriculture in the United States, which needs immediate attention, and which, in my judgment, promises more for the increased usefulness of the institutions which you represent than any other single line of work that these land-grant colleges and experiment stations have heretofore performed.

In order that I may make clear the thought that I wish to convey, permit me to remind you of two or three facts in the history of the new education, which are preliminary and in some degree explanatory of the situation in which we find ourselves to-day.

The agricultural colleges came into existence in response to a demand upon the part of a large number of our citizens who are deeply interested in the future of

the agriculture of this country and who hoped, by the establishment of these institutions, to provide a population for the rural districts which would not only be highly developed as educated men, but which would also have that special training and knowledge which would fit them more completely for the scientific and rational pursuit of agriculture than was possible under the old methods of education provided in the classical schools.

It was believed that large numbers of young men would avail themselves of the education in agriculture which these new colleges undertook to give, and that in the near future the country districts would be well supplied with scientific farmers, who would make agriculture a life pursuit, and be an example and stimulus to others not so fortunate in educational advantages as themselves. The disappointment that followed when it was found that, instead of appreciation, a strong prejudice against this new education was developed on the part of those whom these colleges were intended to benefit was not the only painful experience that these public-spirited citizens had to endure. They found, as well, that there was comparatively little desire on the part of young men for the education that had been provided, and that the courses of study which had been prepared with so much care were despised by the great body of students themselves.

It was very soon seen that the work of education in this new direction would be of slow progress, and that many years must elapse before the hopes of the founders of these colleges could be realized.

Although there was this indifference on the part of young men toward this branch of learning, there was, on the other hand, a strong desire on the part of those who were engaged in the business of farming for agricultural information. To supply this demand the experiment station was brought into operation, and through investigation and experimentation it endeavored to assist agricultural people, by solving questions that they had been unable to determine for themselves through the aid of bulletins published from time to time, and embodying the substance of truths that had been ascertained. Much valuable information was soon collected and distributed throughout the country. It was then found that many of the country people, by reason of their lack of scientific training, were unable to understand the full force and application of the teachings of these scientific investigators, and there arose the necessity for some persons, familiar with science and its relation to practice, to go out through the country districts and explain the meaning of these experiments, and show the farmers how they could use the facts collected and apply them in the conduct of their calling.

Out of this grew the Farmers' Institute, and now, in almost all of the States, this form of instruction is doing much to spread a knowledge of science and her methods, and to familiarize farmers with scientific facts and terms, and to secure the respect of agricultural people for the truths thus presented.

The result of all these agencies is that a great advance has been made, and scientific training and scientific truth have been rapidly gaining in favor among rural people, until it is now quite common to find men conducting their business as farmers upon the best and latest teachings of science, as made known by colleges of agriculture, experiment stations, and institute lectures, that are at work all over the land. Whatever measure of success has been secured in the improvement of agriculture during these late years has been chiefly due to the information and education in science as it applies to rural pursuits that these institutions which I have enumerated have brought to the farming people of this country; and it is now perfectly clear to all thoughtful men that the future prosperity and advancement of agriculture in America must come through the still more general spread of scientific knowledge of their art among rural people, and through new discoveries of science as it affects agricultural methods and practice, brought into use by those engaged in the actual business of farming.

Owing to the influences of which I have spoken and to the low prices of farm products and the consequent small profits of agriculture, there has never been a time in the history of this country when agricultural people were in greater need of knowledge or were more anxious for information in regard to their calling than they are to-day. How shall this urgent and increased demand most speedily and effectively be met? This brings me to the particular point to which I wish to direct your attention this morning.

If improvement of condition has been effected during past years through increased knowledge of better methods in agricultural practice and its dissemination among the farming people, may not this indicate to us the method which ought to be pursued to bring about improved conditions in the future? If these people are suffering from lack of knowledge, is not the remedy very clear and our duty plain?

In Pennsylvania we are trying to supply this necessity in a way that promises success. A single difficulty, however, bars our progress, and it is to the removal of this obstacle that your assistance is invoked.

The State College and Experiment Station have undertaken to carry the latest

and best information in regard to the various branches of modern agriculture into every country home in the State. They have several sets of men out over the State to-day, endeavoring to establish reading circles among the farmers, and are offering books at wholesale prices on the various subjects in which these people are most interested and are endeavoring to aid each reader by such assistance as a corps of more than forty expert professors can render, answering questions, explaining difficulties that arise, and giving all of this free of charge. For more than two years this work has been going on, and now we find that the great obstacle in the way of its complete success is in the unsuitable character of the books that it is possible to obtain and in the great expense that a set sufficiently complete involves.

The remedy for this serious difficulty which confronts us, and provision for supplying this, the essential part of the Agricultural Chautauqua plan, a plan capable of the widest application and which promises to be highly beneficial to millions of agricultural people in the United States and other lands, are suggested in a statement that I shall presently submit for your judgment and action.

The great need just now is for suitable books upon agriculture. Until these are provided the work of the colleges and stations, the institutes, and the Chautauqua course must be seriously retarded, valuable time be wasted, and a great opportunity be endangered, if not entirely lost. The introduction of the study of agriculture into the public schools is also sure to be demanded inside of the next twenty-five years, and will be the next phase in the development of the new education, begun forty years ago. We need to get ready for these new features of the agricultural educational work, and we need to get ready *now*. Books costing from $1 to $2 or $3 each ought to be had for from 15 to 30 cents apiece, and discussions of subjects that occupy 100 pages ought to be condensed, and can be condensed, into 10. Station bulletins, containing much valuable information, and costing many thousands of dollars and years of careful and patient labor to secure, are lying all around in fragmentary form, of little value to the great mass of men, solely because of the lack of some central and competent authority to collect the truths which they have secured, and arrange their teachings in some logical and readable form, for use by those who so much need the information which they contain.

To ask you to constitute such an authority, and set to work at once a corps of competent scientific men arranging this and like information, and providing for its distribution among the agricultural people of this country, is the request that I have come to present, and the method for the accomplishment of this extremely desirable end is suggested in the following statements, which I shall now read, and in the resolution which follows:

"Recognizing that the future development and success of agriculture in the United States is directly dependent upon a more complete knowledge by rural people of improved methods of farming;

"And realizing that the discovery of these improved methods, and the showing of the adaptability of practical and scientific truth to agricultural operations, is the specific duty of the colleges of agriculture and of the experiment stations of the United States:

"And appreciating the fact that their work is comparatively futile, unless the information thus obtained is disseminated among the agricultural people, and is put in useful form;

"And realizing, also, that the bulletins published by the stations and departments of agriculture of the several States and of the nation, although containing much of the latest and best information, do not form a complete and systematic course of instruction in agriculture, but, on the contrary, are quite fragmentary and disconnected;

"And believing that a systematic and complete course of instruction adapted to the use of farmers and embracing the latest and best information known with regard to their occupation is highly desirable, if not an immediate necessity;

"And that in order to secure attention and study on the part of the farming people as a class, the books containing the information should be of attractive form, well illustrated, printed in clear type, on good paper, and be furnished free from copyright and royalty, and that each volume should treat of but one or two subjects, and not be larger than from 75 to 100 pages, so as to enable the purchaser to get what he wants as cheaply as possible and without having to pay for other matter not desirable;

"And being of the conviction that the chief obstacle now in the way of establishing an agricultural Chautauqua course of reading and study for farmers is in the lack of suitable literature and in the expense involved in the purchasing of books;

"And feeling that the need for such a course of reading and instruction is national, and not confined to sectional or State boundaries:

"Therefore, we respectfully request the honorable Secretary of Agriculture of the United States to consider the advisability and propriety of arranging for the editing, under the direction of the national Department of Agriculture, of such a series of books as the necessities of our farming interests seem to require; engaging in their preparation the best scientific assistance that the country affords; purchasing the

copyright, and having the books published for distribution at cost of paper, presswork, binding, and postage; making up a series of works that shall include all of the topics relating to practical agriculture.

"*Resolved*, That a committee of three be appointed to present these suggestions to the honorable Secretary of Agriculture of the United States, and also to render such assistance as may be necessary in securing for the Department of Agriculture such appropriations as will be sufficient to carry out the purpose herein expressed."

In considering this proposition several important questions naturally arise:

(1) Has the Department of Agriculture the legal right to undertake the work?

(2) If it has, is it its duty to organize a force necessary to carry the proposition into effect, or is there another and better method of securing the desired result?

(3) What, in all probability, would be the effect if such a system were inaugurated?

With regard to the first question raised, permit me to call your attention to some of the declarations of the Secretaries who have defined the scope and powers of this Department.

Secretary Rusk, in his report for the year ending June 30, 1890, pages 46 and 47, makes the following statements:

"The measure of the efficiency of the Department of Agriculture is largely its ability to supply practical, useful information to the public. * * * We have found it desirable to cause the publication from time to time of short practical tracts, inexpensive in form, devoted to some special feature of agricultural work, calling for clear, concise instruction, within the comprehension of any person able to read them."

In his report for 1892, page 20, the same Secretary states that—

"In order to fulfill its mission this Department must be prepared to do with reference to agriculture all that our individual farmers are unable to do for themselves. * * * The commission of this Department, as I may call the law under which it was originally established, is broad enough to cover any work which in the judgment of its chief may have a bearing upon agriculture in this country."

A division of records and editing has been in operation in the Department for several years, and during the year ending June 30, 1894, out of 205 different publications issued by the Department 149 were by this division, and the total number of copies of all publications for that year amounted to 3,169,310. The present Secretary, in commenting upon the "Yearbook" for 1894, page 50, states:

"It ought to contain the results of researches made in the various bureaus and laboratories during the year, and should be so plainly written and popular in its character as to adapt itself to the practical farmer and be held in esteem by him as a work of reference on agricultural science, practice, and statistics."

During that year 254 different publications were issued by the Department, aggregating over 4,000,000 copies, or 420,000,000 printed pages, and these were distributed free.

It has been the uniform practice of all the Secretaries to issue such publication of facts relating to agriculture as they deem advisable, and no one can call in question their right so to do. If any doubt should arise, it would be set at rest by the act of Congress approved May 15, 1862. The act creates

"A Department of Agriculture, the general design and duties of which shall be to acquire and diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word."

It being, therefore, clearly within the powers of the Department to collect and publish such information as is proposed in the statement and request submitted in this paper, the way is clear for the consideration of the second question:

Is it its duty to organize a force competent and sufficient to carry the plan into operation, or is there another and better method of securing the desired result?

At present there is not in this country, outside of the Department of Agriculture, any authority or central board of editors authorized or competent to undertake this work. If there were, they would be unwilling to undertake it under the conditions, which contemplate no royalty or copyright, but provide that the publications shall be had at cost. Cheapness is an essential feature of the plan, and to secure this the cost of preparation of the copy would have to be borne by the Department, making the series of books available at the price of paper, presswork, binding, and postage.

If, therefore, this work is to be accomplished in the near future, it will be necessary for the Department of Agriculture to organize a corps of men to outline its scope, and it would also need to secure the assistance of experts in the preparation and compilation of the text.

What would be the effect if such a system were inaugurated?

It might be objected that the publication of such a series of books by the Department would be an infringement upon the rights of private publishing houses, appropriating work that these publishers have a right to expect would be committed to them.

As has been shown, no private publisher can do the work under the conditions

prescribed. There is no profit in it. The books are to be furnished at cost. But it does not follow, because this work is done by the Department of Agriculture and at cost, that private publishers will thereby suffer loss. The introduction of a popular course of reading in agriculture will create a desire for agricultural literature, and perhaps no better method for advertising the class of books that publishers issue on agricultural subjects can be devised than this.

Each of these elementary books ought to contain references to larger works, treating of similar subjects, giving the publisher's name and address, together with the price of the book. Farmers, therefore, who are making a specialty of some particular branch of agriculture, will have at hand a convenient means of discovering where full information can be had in regard to that subject, and would purchase books that they otherwise might not know were in existence. Instead, therefore, of being a disadvantage to the publishers of agricultural books, this course of instruction would prove the best possible advertisement for their trade.

There would also be created a demand for new books upon agricultural topics. This would give remunerative employment to many scientific men who are now deterred from entering this field of labor because of the limited demand. Professors in the colleges and experiment stations would be put in position to thereby greatly enlarge their field of usefulness, and at the same time supplement their usually quite meager salaries.

In addition to what has been stated, the farmers of the country, through the influence of this course of reading, would be brought to appreciate more fully the work of the higher institutions of learning and of the experiment stations, and be more likely to send their sons and daughters to these colleges, to secure the training and knowledge which the parents had found to be beneficial to themselves.

Its influence would also be felt by the primary schools in the country. An awakened and informed community would insist that so much of science as could be taught should be introduced into the public schools, and being themselves in control, they would be able to see that their wishes were carried into effect.

Therefore, on every account, it would seem to be the duty of the Department of Agriculture to undertake this work, and thus aid the great body of agricultural people in what is now their most pressing need.

After some discussion the suggestions of this paper were referred to a committee of three for consideration and report at the next convention (see p. 63).

Mr. True. I would like to present the report of the bibliographer of the Association. (This was a list[1] of 1,450 books and pamphlets on agriculture and the associated sciences, which had appeared within the last four years.)

The Chairman. If there is no objection, the report is considered adopted.

Mr. Goodell. Since we are on the subject of books, I wish to say that the committee to which was referred the subject of indexing agricultural literature, consisting of Dr. True, Professor Hays, and myself, have carefully considered that subject during the year, and have prepared a provisional list of works on agricultural subjects. We find that list already amounts to two thousand titles, and we have not commenced to cover the ground. After consultation and receiving a letter from Professor Hays, who, I am sorry to say, is not here, I move that a committee of five, one of whom shall be the librarian of the Department of Agriculture, be appointed to consider this matter of indexing agricultural literature.

Carried.

The Chairman. The Chair announces as members of the committee to wait on the Commissioner of Education and urge the preparation of a statistical table, A. W. Harris, of Maine; J. L. Goodnight, of West Virginia, and J. E. Stubbs, of Nevada.

The Chairman. We will now have the report of President Murkland on entrance requirements, courses of study, and degrees.

Report of Committee on Entrance Requirements, Courses of Study, and Degrees.

Your committee, appointed November, 1894, and continued with further instructions at the last annual meeting of this Association, presents the following report:

ARTICLE I.

Section 1. Congress, in establishing and endowing the institutions known as the land-grant colleges, evidently intended that their work for the classes they were

[1] U. S. Dept. Agr., Office of Experiment Stations Circ. 31.

designed to benefit should be, as far as practicable, uniform in scope and character in the different States and Territories. It is inevitable, however, that this uniformity, desirable as it is, should be somewhat limited or conditioned by the environment of each college.

SEC. 2. The act of 1890, further endowing these colleges, points to their development along certain specified lines. In conformity with the spirit of this act these institutions are constantly tending to become schools or institutes of technology. That they must be collegiate in scope is required by the law itself.

SEC. 3. The steadily increasing tendency to ignore and obliterate all State lines in scientific and educational work; the free intercourse in social and industrial life among the people of the several States, and, in consequence, the steadily broadening field of usefulness and activity open to the graduates of educational institutions; the association of the land-grant colleges into a national organization for the protection and promotion of their common interests; the increasing recognition by the National Government of the importance and promise of the work of these colleges—all these considerations make it desirable that the degree or degrees awarded by these colleges should represent work approximately uniform in character and scope; should be, in other words, degrees of such recognized value as to pass current, each the equivalent of the others, in any State or Territory.

SEC. 4. It is clearly recognized that the social and educational conditions prevailing in the several States make it impossible, for the present, to prescribe uniform requirements for admission into the colleges of this class. In some States, for some time to come, concession must be made to the defective condition of the public-school system. But it by no means follows that in making such concessions the colleges are prohibited from protecting their standards of work and graduation. These, by proper effort, may be maintained and made to conform in educational value to those of the colleges which are more happily situated. Moreover, a certain community of interest makes it the duty of each college to protect at the same time its own reputation for thorough educational work and the reputation of its sister institutions.

SEC. 5. The educational conditions prevailing in the United States make it impossible to require of students in schools of applied science or technology that their liberal training should be acquired in preparatory schools. These institutions, therefore, can not exclusively confine their attention to technical subjects. They must include in their courses for graduation certain elements of a liberal (or general) education.

SEC. 6. These considerations, thus briefly outlined, make it desirable that all colleges in membership with this Association should unite in requiring for the bachelor's degree, or degrees, at least the following general studies:

Mathematics—At least through algebra, geometry, and trigonometry.
Physics and chemistry, with laboratory work in each.
English language and literature—At least two years' work.
Other languages (one, at least, modern)—Four years. [1]
Mental science and logic or moral science—One year.
Constitutional law.
Social, political, or economic science—One year.

SEC. 7. It is desirable, also, that the bachelor's degree, or degrees, should represent an approximate uniformity in the amount of work done in the several colleges. The conditions generally affecting these colleges are such that a greater amount of work is demanded of their students than is required in the colleges of longer standing and other traditions. In the judgment of your committee it is not too much to require the equivalent of fifteen hours per week of recitations and lectures, together with ten hours per week of laboratory work or practicums, including the time devoted to military science and drill. Upon this basis, the above-mentioned general studies should be assigned a relative importance approximately as follows:

	Hours.		Hours.
Algebra	75	Modern languages	340
Geometry	40	Psychology	60
Trigonometry	40	Ethics or logic	40
Physics (class-room work)	75	Political economy	60
Physics (laboratory work)	75	General history	80
Chemistry (class-room work)	75	Constitutional law	50
Chemistry (laboratory work)	75		
English	200	Total	1,285

The total number of hours included in a four years' course, allowing fifteen hours per week for thirty-six weeks, would be 2,160; with ten hours' laboratory work or

[1] The statement "four years" means 340 hours. These may be distributed over four, three, or two years, or confined to one year.

practicums added, 3,600. In general terms, therefore, the foregoing general studies should comprise about two-fifths of the work required for a bachelor's degree.

SEC. 8. It is recommended that in the establishment and nomenclature of degrees the colleges should strictly observe the doctrine of parsimony, and that only the baccalaureate degree of bachelor of science be conferred for a technical course of four years.

Statement, in the diploma, that the degree is conferred for the accomplishment of the course in agriculture, engineering, chemistry, etc., would afford differentiation enough to distinguish the several varieties of the degree.

ARTICLE II.—ENTRANCE REQUIREMENTS.

SECTION 1. The difference in the character of the school systems, both public and private, of the several States is too great, in the opinion of the committee, to permit the formulation of rigid entrance requirements applicable to all the colleges having membership in this Association.

SEC. 2. But the committee holds that it is advisable, as a beginning, to determine the requirements in a few subjects upon which it is possible for all the colleges to agree, and to recommend others which, although too high at present for adoption by some of these institutions, may yet serve as a standard or goal toward which effort may be directed.

SEC. 3. As a standard series of entrance requirements, to be adopted as soon as possible, we recommend the following:

(1) Physical geography.
(2) United States history.
(3) Arithmetic, including the metric system.
(4) Algebra, to quadratics.
(5) English grammar and composition, together with the English requirements of the New England Association of Colleges and Preparatory Schools.
(6) Plane geometry.
(7) One foreign language.
(8) One of the natural sciences.
(9) Ancient, general, or English history.

SEC. 4. From a careful examination of the catalogues we believe it to be practicable, either now or in the near future, for these institutions to unite in requiring as a minimum for admission to their lowest collegiate class:

(1) Physical geography.
(2) United States history.
(3) Arithmetic, including the metric system.
(4) Algebra, to quadratics.
(5) English grammar and composition, together with the English requirements of the New England Association of Colleges and Preparatory Schools.

ARTICLE III.

We recommend that the conclusions embodied in this report be adopted as indicating essentially the position of this Association, with the express declaration, however, that the Association in adopting this report does not attempt to exercise any function other than an advisory one, and that any attempt to enforce an arbitrary uniformity would result in unmixed evil. These conclusions may be summed up as follows:

(1) That two series of entrance requirements, a standard series and a minimum series, be approved by the Association, and that the two series herein given be so approved.

(2) That approximately fifteen hours be devoted to recitations or lectures each week for thirty-six weeks each year; that ten hours laboratory work or practicums be added.

(3) That the list of studies given in section 7 of this report be included in every course leading to a bachelor's degree.

(4) That the degree of bachelor of science be recognized as the standard degree conferred by the colleges of this Association.

Respectfully submitted.

CHAS. S. MURKLAND,
ABRAM W. HARRIS,
GEO. W. ATHERTON,
J. M. MCBRYDE,
THOS. F. HUNT,
Committee.

The report was referred to the executive committee with directions to place it in the order of business on the following morning. (See p. 59.)

The CHAIRMAN. The time has passed for receiving the reports of the committees, and we have barely time enough left for regular business. The next item is a consideration of the amendment to the constitution changing the name of the Association.

Mr. SILVESTER. President Patterson informed me yesterday that, as I was the author of the resolution, he desired that I should present to-day the resolution offered in this hall two years ago. As then offered it was:

Resolved, That the name of this Association be changed to "An Association of American Colleges for the Advancement of Agriculture and Mechanic Arts."

After some discussion it was voted to refer the question to a committee of five to be appointed by the President. (See p. 56.)

The CHAIRMAN. President Holladay asks unanimous consent to introduce a resolution of congratulation to Senator Morrill.

RESOLUTION OF CONGRATULATION TO SENATOR MORRILL.

Whereas the Association of American Agricultural College and Experiment Stations learns with pleasure that the Hon. Justin S. Morrill, now more than fourscore years of age, the patriarch and nestor of the Senate of the United States, has lately been reelected for the sixth time to a seat in that body by a majority approaching unanimity: Therefore, be it

Resolved, That the congratulations of this Association be, and are hereby, tendered to the Hon. Justin S. Morrill, on his receiving so impressive and well merited a tribute to his character, talents, and distinguished public services.

That this Association wishes for Senator Morrill many years to come of life, happiness, and usefulness as an inspiring example to the youth of our country.

That the secretary of this Association is requested to place this resolution on record with the proceedings of this convention and to forward an engrossed copy of the same to Senator Morrill.

The resolution was referred to the executive committee and reported back with recommendation for its adoption.

Adopted.

Adjourned to meet at 7.30 p. m.

EVENING SESSION, WEDNESDAY, NOVEMBER 11, 1896.

The convention was called to order by President Johnson at 7.30 p. m.

Mr. Battle offered the following resolution:

Resolved, That in furtherance of the resolution in regard to seed examinations as recommended by the executive committee and adopted by the Association (see p. 48), a committee of five be appointed by the president to carry on the work as outlined by the resolution.

Adopted.

The CHAIRMAN. We will now listen to an address by C. W. Dabney, jr., the Assistant Secretary of Agriculture, on civil service in the Department of Agriculture.

Dr. Dabney's paper, which has been published elsewhere,[1] discussed in detail the growth in recent years and the present condition of civil service in this Department. All employees above the grade of unskilled laborer or worker, except the Secretary, Assistant Secretary, and Chief of the Weather Bureau, are now in the classified service. A plan of examinations for establishing lists of eligibles suited to the requirements of the Department was outlined. The main object of this plan is to afford opportunities for graduates of agricultural colleges and technical schools to enter, through competitive examinations, not only the higher positions, but also to receive "temporary employment in the minor positions of the Department where they would have opportunities for observation and study which would fit them for better work," and ultimately for promotion to the higher grades.

The need of an administrative officer who could give continuity to the scientific work of the Department was pointed out. The Secretary of Agriculture has recommended to Congress the appointment of an additional officer in the Department "to be known as director-in-chief of scientific bureaus and investigations, who shall continue in office during good behavior, and perform such duties as the Secretary may assign him."

[1] U. S. Dept. Agr., Office of Experiment Stations Circ. 33.

The CHAIRMAN. The Chair will announce the following committees:

Committee on nominations: J. H. Smart, of Indiana; A. T. Neale, of Delaware; P. H. Mell, of Alabama; G. E. MacLean, of Nebraska; B. F. Koons, of Connecticut; W. A. Henry, of Wisconsin; A. Q. Holladay, of North Carolina; H. E. Alvord, of Washington, D. C., and J. H. Connell, of Texas.

Committee on changing the name of the Association: G. E. MacLean, of Nebraska; R. W. Silvester, of Maryland; W. M. Liggett, of Minnesota; W. A. Henry, of Wisconsin, and J. H. Washburn, of Rhode Island.

Committee on indexing agricultural literature: A. C. True, of Washington, D. C.; W. M. Hays, of Minnesota; the Librarian of the Department of Agriculture (W. P. Cutter); H. P. Armsby, of Pennsylvania, and E. Davenport, of Illinois.

Mr. SMITH. I desire to introduce a resolution in support of a bill now pending in Congress providing for a director-in-chief of scientific bureaus and investigations in the Department of Agriculture.

Whereas the Committee on Agriculture and Forestry of the United States Senate has reported a bill to provide for a director-in-chief of scientific bureaus and investigations in the Department of Agriculture, with the recommendation that the same do pass; and

Whereas the work of the various agricultural colleges and experiment stations has brought those institutions into relations with the Department of Agriculture of such a character that any important change in the administration of the affairs of that Department must necessarily affect the success and welfare of the colleges and stations: Therefore, be it

Resolved, By the Association of American Agricultural Colleges and Experiment Stations that the creation of the proposed office and the appointment thereto of a broadly educated scientific man, who shall hold office during good behavior, would be of the highest value to the cause of scientific agriculture in the continuity of purpose and harmonization of operations that should result from the labors and influence of such an officer.

Referred to the executive committee. (See p. 58.)

Mr. SMART. When the Morrill bill was pending in Congress the committee in charge felt the need of a little more help than they had in Washington so they invited the master of the National Grange to assist them, and I am sure I am telling no secret when I say that he rendered extraordinary services in passing that bill. Colonel Brigham is sitting here now, and I move that we give him the floor and recognize the importance of the service he rendered on that occasion.

Carried.

Mr. BRIGHAM. Mr. President and gentlemen, I appreciate the fact that you are full of business and that your time is limited, but I am pleased to have the opportunity to say that we are all deeply interested in the work in which you are engaged. At the time to which the gentleman refers, I came with two other gentlemen, representing organizations with which I am connected, to help pass the first measure relating to agricultural experiment stations and to provide for their establishment. I introduced in the Ohio legislature and asked the passage of the measure establishing the station in Ohio. I have always been greatly interested in your work and I believe every citizen of our country is interested in its success. I have never felt we were asking for anything specially for the farmer when we were asking legislation to help on the work in which you are engaged. We are all dependent upon agriculture. And if we can learn how to cheapen the cost and protect the layman, every individual in every country is benefited thereby.

Now, there are several organizations and associations that are laboring to do that for the purpose of developing and building up agriculture. You are doing a very great work. You have, however, only just commenced. There are some farmers who do not appreciate it, but they are beginning to do so, and will more and more.

I can assure you that the organization that I represent, and which is represented by several others here, is in thorough sympathy with the objects which you have in view and in the work in which you are engaged; we cooperate in every way possible to promote the interests of agriculture and of our people generally.

I have no suggestion to make with regard to the details of your work, but I want

to assure you, in conclusion, that all of us work heartily for the purpose of benefiting agriculture, some of us on different lines from those on which you are working; but it is a mistake, a great mistake, for us to get in one another's way or to throw any obstacle in one another's way. We can criticise if we criticise justly, and good will come of it.

I can assure you from my visits throughout the country, from my association with the representatives here to-day, that you may look to the Patrons of Husbandry for help in every effort you are making for the good of the farmer and for agriculture. We need your help and we appreciate the good you are doing, and may God speed you in your important work.

Mr. True presented the report of the committee on methods of teaching agriculture, as follows:

REPORT OF COMMITTEE ON METHODS OF TEACHING AGRICULTURE.[1]

Need of uniformity in the study of agriculture.—The committee on methods of teaching agriculture submit a report of progress. From the outset of its work the committee has recognized the fact that a thorough investigation of the subject intrusted to it would require a long time. It has therefore endeavored during the past year simply to lay the foundation for future work. The first thing was to find out what was done in this country in the teaching of agriculture. A circular of inquiry sent out for the committee by the Office of Experiment Stations has elicited responses from about fifty colleges. These replies, grouped under thirteen general heads, have been tabulated and brief summaries have been prepared which will be submitted as a part of this report. A large amount of data has been collated in this way which will be useful in further studies in this line.

The general conclusion thus far drawn from an examination of the data, though a negative one, is well worthy of the serious consideration of the association. It is plainly shown that there exists at present in this country no standard for instruction in agriculture. There is a bewildering variety as regards the topics taught, the time devoted to each topic, the order in which the different topics occur in the course, the relative amounts of class-room work and laboratory or practical exercises, etc. Granting all that ought to be conceded because of local conditions, it is nevertheless obvious that general progress in the teaching of agriculture in college courses can hardly be expected until there is greater uniformity in planning and conducting the course of study in this subject. Toward securing reasonable uniformity in this matter it behooves this Association, as well as the individual teachers of agriculture, to give earnest heed.

The committee is not prepared at this time to go much beyond this simple declaration of the great need of studying this subject thoroughly and deeply. More time must be spent in digesting the data collected and in discussing the evidence adduced before detailed conclusions can be drawn. On one point, however, the committee wishes to present to the Association some further considerations.

Necessity of definite nomenclature.—One great obstacle to the intelligent discussion of the scheme of agricultural instruction and the methods of agricultural teaching is the lack of a definite nomenclature of the subject. This confusion of terms is evident in the data collected by the committee, as well as in much of the current discussion of this subject which appears in the public prints. It is obviously not an easy matter to bring order out of confusion in such a case. The committee has not been able to give time enough to this phase of the subject to definitely settle anything even in the minds of its own members. It proposes, however, to suggest for the consideration of the Association a tentative scheme for the division of what is commonly designated agriculture in courses of study into several distinct branches or subdivisions, and for giving each of these branches a definite name, as follows:

Agriculture..	1. Agronomy, or agriculture (technical).	Climate, soils, fertilizers, and crops—plant production.
	2. Zootechny, or animal industry.	Animal physiology and animal production.
	3. Agrotechny, or agricultural technology.	Agricultural industries, e. g., dairying, sugar making.
	4. Rural engineering, farm mechanics, or farm equipment.	Roads, drains, irrigation systems, farm buildings, etc.
	5. Rural economy, or farm management.	General policy of farm management, rural law, agricultural bookkeeping, etc.

[1] This report, with accompanying papers on Some features of European institutions for agricultural education, by A. C. True, and Notes on agricultural education in the Scandinavian countries, by F. W. Woll, has been published as Circular 32 of the Office of Experiment Stations of the U. S. Department of Agriculture.

If we can reach a point where the term *agriculture*, as applied to what is taught on agricultural subjects in a college course, shall generally be understood to include at its widest the five subordinate subjects indicated in the above scheme, and in its restricted sense only what applies to plant production, an important step will have been taken in settling the proper boundaries of agricultural instruction and in fixing the proper subdivisions of the general subject. It is probable that the substitution of a more definite and technical term for agriculture in its restricted sense would simplify matters. The term agronomy is tentatively suggested as such a term, and the opinion of members of the Association on this, as well as on the other terms suggested, is invited.

Courses in agriculture in foreign schools.—Before presenting the summary of data collected by the committee it may be well to add that examination of the courses in agriculture in foreign schools was made, as far as practicable. One member of the committee had the privilege of visiting representative agricultural schools in Germany, France, Belgium, and Holland during the past summer, and holding personal conferences with leading agricultural educators in these countries. The general results of his observations will be given in a brief paper appended to this report. At the suggestion of the Director of the Office of Experiment Stations, Prof. F. W. Woll, of Wisconsin, made a special investigation of agricultural institutions in Denmark, Norway, and Sweden during a vacation trip last summer. A brief statement of the results of his observations is also appended to this report, and it is hoped that he will present a longer account in the Experiment Station Record.

J. H. Connell,
A. C. True,
T. F. Hunt,
H. T. French,
H. H. Wing,
Committee.

November 10, 1896.

Mr. Goodell. It will be remembered that in one of the early sessions of this convention an invitation was extended to the members of the National Grange, in session in this city, to attend the meetings of this convention. In acceptance of that invitation a number of the officers of the National Grange and a number of the masters of State Granges have been with us to-night. During a recess of this convention to-day a committee from the National Grange, acting upon its order, waited upon the officers of this Association and extended to the delegates of the Association an invitation to meet with them in their general session to-morrow forenoon.

I move, therefore, that the general session of this convention to-morrow morning adjourn at 11 o'clock for the purpose of proceeding in a body to the National Hotel and remaining a few moments in assembly with the Patrons of Husbandry

Carried.

The convention then adjourned to 9.30 o'clock the following morning.

Morning Session, Thursday, November 12, 1896.

The convention was called to order at 9.30 a. m. by President Johnson.

Mr. Goodell. I am directed by the executive committee to make report on the resolution offered by Director C. D. Smith in regard to a director-in-chief of scientific bureaus in the Department of Agriculture (see p. 56), with a recommendation that it be adopted.

After some discussion the resolution was adopted.

Mr. Goodell. I will now read a resolution introduced by Chancellor MacLean:

Whereas the present system of weights and measures in use in the United States militates seriously against our trade with foreign countries, and in order to better facilitate comparisons of experimental data obtained at home and abroad, as well as to effect an important saving of time in the education of our youth; and furthermore in view of the rapid growth of the country, which increases continually the difficulties involved in a change: Therefore, be it

Resolved, That this Association, through its executive committee, transmit a communication to Congress urging the importance of the early adoption of the metric system of weights and measures as the only legal standard for the United States.

The executive committee recommend the adoption of this resolution.

Adopted.

Mr. GOODELL. I will now read a resolution introduced by the Section on Entomology and referred to the executive committee for report:

Whereas recent serious outbreaks in several States of the Union of insect pests of such pernicious and destructive character as the San José scale, the Mexican cotton-boll weevil, migratory locusts, the chinch bug, the army worm, the gypsy moth, the leopard moth, and other species calls for the exercise, on the part of official entomologists, of extraordinary police powers, the adoption of extreme methods of treatment, and the expenditure of considerable sums of money in work which is more strictly economic than scientific; and

Whereas the past history of the introduction of insect pests is such as to give sure ground for the belief that further serious pests to fruit and farm crops will be continually introduced into this country: Therefore, be it

Resolved, first, that it is the sense of this Association that the institutions herein represented should take steps to secure carefully considered legislation in all States which possess no insect-pest laws and to secure revision of such unsatisfactory laws as already exist, with the object that this legislation should give to the directors of the several experiment stations such powers as may be necessary, under their various circumstances, to properly deal with this subject; and

Resolved, second, that in the opinion of this Association it is imperative that immediate steps be taken to control the dissemination of the San José scale upon nursery stock by means of properly authorized inspectors in every State.

The executive committee reports back the preamble and resolution, deeming it inexpedient as a matter of general policy for this Association to attempt to influence legislation in the various States (see p. 110).

The CHAIRMAN. There being no objection, the report of the executive committee is approved.

Mr. GOODELL. I have here the report of the committee on entrance requirements, courses of studies, and degrees (see p. 54), which was referred to the executive committee. The executive committee recommend the adoption of the report of the committee on entrance requirements, courses of studies, and degrees, as presented by the committee, with this prefatory declaration, to wit:

That the schemes of studies presented for admission to the colleges and for graduation therefrom are suggestive and tentative, not to be considered as of necessity or binding upon the colleges which may assent to the adoption of said report, and subject, without prejudice as to equal efficiency, to such substitutions of other studies of equal and similar educative value for those named in the schemes as the peculiar conditions of the several colleges may make necessary.

Mr. WILSON. Before the question of adoption of the report is put I would like to have a discussion of this subject.

Mr. FAIRCHILD. While I should be very much pleased to have the four years of languages put in as elective with an equal quantity of exact or applied sciences, I am willing that the report should be adopted with the amendments which the executive committee have prefixed, provided that it be explicitly stated that the course is four years in length.

Mr. SMITH. It seems to me that if the report means anything, it is ill advised to introduce it now. If it means nothing, then there is no necessity for its introduction. Both our theory and our practice are not in accordance with the suggestions of the report.

Mr. WILSON. I desire to call attention to the fact that the report specifies a course of four years.

Mr. HARRIS. It means three hundred and forty hours, which may be distributed over two or three or four years. The recommendation of the committee was that it should be distributed over two years, but I see that it is printed here *four* years.

Mr. WILSON. Then it should be corrected.

Mr. WASHBURN. It has been suggested by a gentleman here that his trustees would not be in favor of putting in two years in the study of modern languages. Then do not do it. Nobody has asked it. He says it is not of any advantage to the farmers of his State. That may be true. The question is, What shall we give for a degree of bachelor of science, and only that? The only point the committee, as I understand, wants to make, is the minimum amount of work which should be given

to the students who receive the degree of bachelor of science. The same colleges that are giving that degree can take in men who do not know how to read and write. If they can do some of the practical and laboratory work, the colleges can take them in and educate them, but they do not want to put themselves on record as colleges giving charlatan degrees. That is the only point. If the agricultural colleges are going to give a degree, let them give a degree that is good for something, and educate any kind of a man as far as he can go.

Mr. SNYDER. I notice that according to this schedule 150 hours are given to physics and chemistry with 150 more for laboratory work. That is, this scheme proposes to give 300 hours to physics and chemistry (botany is not mentioned at all), and to give 340 hours to modern languages, for the degree of bachelor of science.

Mr. WASHBURN. The report is not a course of study. It is only a framework, and represents only about two-fifths of the work.

Mr. SNYDER. Then the other three-fifths ought to be indicated.

Mr. WASHBURN. You can fill that out as you please.

Mr. SNYDER. If this report means anything, it means that more time should be given to modern languages than to science.

Mr. FAIRCHILD. Bachelor of science does not mean languages. It does not in any sense of the word mean that there must be a certain amount of foreign or ancient languages, and among the scientific men of our country to-day there are many who have mastered the tools of science outside of such a course of study, and only because they had the training in science and because they found their way to these tools through science.

Now this report emphasizes the foreign languages in a way which to my mind is unnecessary. I have been connected for thirty-two years with colleges which have not taught the languages as necessary to the degree of bachelor of science, and yet out of those colleges have come some of the best men whom you can recognize here to-day. Is it right and proper to insist that modern languages are necessary for the degree of bachelor of science when it may not be required for the degree of bachelor of arts? Why emphasize language in such a proposition?

Mr. MYERS. There is so much division in regard to this matter that I move the report be referred back to the committee.

Mr. WILSON. This motion permits some discussion and I want to say but a word. I came here almost entirely for the purpose of getting some light to assist me in building up a four-year agricultural course. We have been stumbling six years to do that, and recognizing your great ability in other directions I supposed there would be no trouble in getting some light on how to teach agriculture. It is not a question of arranging curricula of the ordinary studies, but what are we going to do with the farmer's boy whom we take from the farm and send back to help educate the neighborhood? That is what brought me over the Mississippi and across the Alleghany Mountains.

Now, the only place where you would interfere with us would be in the requirements of algebra. We have boys who live about 20 miles from where algebra is taught, and if they come without a knowledge of algebra we must send them home or take them as we find them. At our own solicitation our trustees permitted us to take such boys in and begin with algebra, and when graduation came they were not behind the others. These husky farm boys always account for themselves. It is not a question about entrance. You can leave that to our judgment. It is a question of graduation. What the people want to know is what we are doing as educators. It is not a question whether we are going to measure ourselves up along side of the classical colleges and see how near we come to them. The question is, What are we doing for the farmer's boy and the mechanic's boy? I regret that this question has been raised here at all at this time.

Mr. MYERS. I move to refer this matter back to the committee for further consideration and report.

Mr. WHITE. Let me suggest that if the convention should be pleased to adopt the

report of the executive committee, it would be a reference of the entire matter to the committee of the whole, which would be a recommittal to the small committee that originally had it in charge. If the members of the convention will bear in mind the exact phraseology of that preamble it will be observed that the whole scheme is accepted tentatively. I think we should study it carefully and come back next year with suggestions looking to its improvement. If you refer it back to the committee it will disappear from the sight of the convention and all of us who have not charge of its consideration. I think it would be better to adopt the report of the executive committee and let it be printed in the proceedings of this Association.

I therefore move the previous question on the adoption of the report of the executive committee.

Mr. MYERS. The motion before the house is to refer that matter back to the original committee.

Mr. MURKLAND. A pretty full view of every objection which has been urged was taken by the committee, and it was because of such objections and because the committee viewed them in every light in which they could see the objections, that the report was presented in its present form. To refer it back to this committee would attain no worthy end, and it seems to me that the question really is whether or not we wish to have these colleges stand for anything before the people of the country. It is a question, as the gentleman from Iowa has suggested, as to the manner in which we are administering the trust referred to us by the land-grant acts, acts by which we are absolutely compelled to maintain our institutions upon a collegiate basis; and with a desire to emphasize the determination of these colleges to carry out the provisions of these acts in strict loyalty and in perfect honor these resolutions have been presented. To refer them back to the committee would seem to imply—I do not say it would—but it would seem to imply that we are unable to meet the absolute requirements that Congress has imposed upon us. As to the question of detail, much has been said and ably stated by other members of this committee.

It was my great pleasure for a few moments yesterday evening to meet the honorable gentleman who so thoroughly represents the cause of education in the national administration, and to leave with him a copy of this report with the hope that he might be with us this morning. I am delighted to see that he has just entered the hall, and I will gladly surrender any time which may belong to me to the Hon. William T. Harris, Commissioner of Education.

The CHAIRMAN. I speak the sentiment of this convention when I request that Dr. Harris give us his views on this or any subject which is before us.

Commissioner HARRIS. I know very little about the instruction in agriculture in the colleges, although I confess to a great deal of interest in it. I have looked over the report of your committee and must say that it seems to me to be a very wise report. It gives mathematics to the student of agriculture. It takes up the principles of numbers and the philosophy of space in geometry and the application of that knowledge in actual practice, in surveying, mechanics, etc. The fundamental principles of time and space have been wisely placed by your committee first in the list of studies recommended as requirements for the bachelor degree. They furnish the great basis for dealing with the world of matter or world of motion. Physics and chemistry are properly placed after mathematics by this committee because they are an application of mathematics.

We find next, English language and literature, to which the committee assigns 200 hours. Now the farmer's boy wants to know the great literary productions of the human race, because this knowledge will aid him in judging human nature. The person who knows human nature is of course armed at all points against imposition.

Mental science is put in the course. A citizen as well as a farmer should have some knowledge of that. This represents only 40 per cent of the programme. Sixty per cent of the programme is left for other things.

It is the intention, I suppose, to fill up the 60 per cent of the programme not

named with studies that will develop and make practical this directive power. The study of algebra, chemistry, physics, foreign languages, logic, and the like, would seem to fit him for some other industry or for a profession, but 60 per cent of his time is used in gaining directive power. In general, I believe that the object of the agricultural colleges should be to take the boy from the farm, make him a man of directive power, and put him back on the farm.

Now, I wish to say a word in closing of the relation of the farmer to the other kinds of industry, and call attention to an obvious fact, which is that these colleges tend more toward mechanical industry than they do toward farming. I suppose everyone admits that. The instruction in agriculture has not been reduced to a pedagogical form. The agricultural colleges, therefore, have had to begin with raw material, as it were, and work it into shape, and have thus been at a disadvantage. I want to say, however, that it is a good thing that mechanical industries are so intimately connected with agriculture in these colleges.

The report of the committee was adopted by a rising vote of 34 ayes to 11 noes.

Mr. GOODELL. I have here a resolution introduced by Mr. Hamilton, of Pennsylvania, having reference to the publication of books connected with agriculture. (This resolution is given in Professor Hamilton's address, on page 50.)

The executive committee report back this preamble and resolution and recommend that a special committee of three, to be known as the committee on farmers' institutes, be appointed by the president to consider all matters pertaining to farmers' institutes and report at the next convention, and that Professor Hamilton's paper be referred to it for consideration.

Carried.

Mr. GOODELL. I am instructed by the executive committee to give an opportunity at this time for anyone desiring to present an invitation for the meeting of the convention next year.

Mr. LIGGETT. On behalf of the board of regents and the faculty of the Agricultural College of Minnesota, I extend to you a most cordial invitation to meet with us next year, and in doing so I would suggest that a summer meeting be held, because I think it would be very much more enjoyable.

Invitations were also extended from the experiment station at Geneva, N. Y., by W. H Jordan, and from the station at Wooster, Ohio, by C. E. Thorne.

(At this point Senator Morrill appeared in the hall and met with an enthusiastic reception.)

Mr. MACLEAN. I wish to say that the committee on name of the Association has agreed unanimously on a report, and if the convention is in the same frame of mind as the committee, it might be well to let that committee report at once and have a long rest upon the subject of name.

We agreed to have a name which would describe just what we have in the most direct English possible, and we all agreed in that these colleges, without being limited in their liberty, are primarily for agriculture and the mechanic arts; and that the experiment stations should retain a place in the name of the Association. We believe there will never be peace in this Association so long as we have a descriptive name that ignored the mechanic arts.

After prolonged discussion, which was carried into the evening session, the resolution to change the name of the Association was lost by a vote of 37 to 16.

The CHAIRMAN. It will give us great pleasure to hear from our old friend and father, Senator Morrill.

Senator MORRILL. Mr. President and gentlemen, I am sure that I did not come here for the purpose of making a speech when all the new members who are present are loaded with one and anxious to get it off. I am not present for the purpose of making any observations. I know not what topic is under consideration. I do not wish to interfere with it, but my own impression is that the agricultural colleges and experiment stations are all in a tolerably prosperous condition, and therefore I am here for the purpose of seeing some of my old friends that I used to see thirty odd years ago

when I was laboring to get the institutions established. As these institutions seem to be established permanently, I do not think that I have now any further observations to make.

Mr. SMART. I desire to make a report from the committee on nominations, which I will ask the secretary to read for me:

Your committee appointed to nominate officers of the Association for the ensuing year and to name the committee on nomenclature have the honor to present the following recommendations:

For President.—G. T. Fairchild, of Kansas.

For Vice-Presidents.—(1) M. H. Buckham, of Vermont; (2) James Wilson, of Iowa; (3) J. M. McBryde, of Virginia; (4) A. Kingsbury, of New Hampshire; (5) J. E. Stubbs, of Nevada.

For Secretary and Treasurer.—J. H. Washburn, of Rhode Island.

For Executive Committee.—H. H. Goodell, of Massachusetts; H. C. White, of Georgia; A. Cope, of Ohio; T. J. Burrill, of Illinois; and the ex officio members provided for by the constitution, the president, the junior ex-president (S. W. Johnson, of Connecticut), and the secretary and treasurer.

For Bibliographer.—A. C. True, of Washington, D. C.

For Committee on Nomenclature.—H. P. Armsby, of Pennsylvania; E. H. Jenkins, of Connecticut; S. M. Tracy, of Mississippi; C. P. Gillette, of Colorado; and A. C. True, of Washington, D. C.

On motion of G. W. Atherton the secretary was instructed to cast the vote of the Association for the officers named by the committee.

Mr. ATHERTON. The Association here assembled represents institutions which are all the legislative children of our honored friend who has already addressed us. We all feel in this Association something of the inspiration that comes from contact on the one side with the Government of the United States and on the other with the great propelling life of the people of this great democracy moving forward to a destiny which we all believe in, so magnificent and unparalleled; and as the act of 1862 was the first to put into definite form the germ of that conception which is so vitalizing and revolutionizing the educational ideas and methods of the United States, and as Senator Morrill will always remain connected with that great act as the first interpretation of that great impulse and inspiration, I am sure that all of us would like to have an opportunity to take him by the hand, if the burden to him would not be too great, as we pass out in adjourning.

I move that we now adjourn, in order that we may have an opportunity to pass in review and express to Senator Morrill our warm and affectionate regard and reverence.

Mr. GOODELL. I will second that motion. Permit me to give a notice before it is put. Immediately after adjournment the Association will proceed to the National Hotel, where the Patrons of Husbandry are now in session, and exchange fraternal greeting. Returning from lunch at precisely 1 o'clock the members will assemble in the East Room of the White House for the purpose of calling on President Cleveland.

Thereupon the motion of Mr. Atherton was carried, and the convention adjourned.

EVENING SESSION, THURSDAY, NOVEMBER 12, 1896.

The general session convened in Grand Army Hall at 7:30 p. m., President S. W. Johnson presiding.

The CHAIRMAN. The chair will announce as members of the committee on farmers' institutes, C. W. Dabney, jr., of Washington, D. C.; W. H. Jordan, of New York, and W. A. Henry, of Wisconsin. As the members of the committee on seed testing, E. H. Jenkins, of Connecticut; G. H. Hicks, of the U. S. Department of Agriculture; G. McCarthy, of North Carolina; F. W. Card, of Nebraska, and W. R. Lazenby, of Ohio.

Mr. GOODELL. There is a large amount of business to be transacted this evening, and I move that the evening be devoted simply to business and not to the consideration of other matters on the programme.

Carried.

Mr. ALVORD. A special committee was appointed at the ninth annual convention

of the Association at Denver, with instructions "to codify the resolutions and declarations of previous meetings of this Association concerning uniformity in action on the part of colleges and stations in matters of common interest," which committee now respectfully reports:

The printed proceedings of eight annual conventions, and such records of the Washington convention of 1887 as exist, have been carefully examined. From these all resolutions and declarations which may be included by the language defining the duties of this committee and a few other declarations of the Association regarding its own affairs which it seems desirable to bring together and present for review have been copied. These abstracts have been arranged according to their character and bearing, with notes showing when and where adopted and where printed. In a few instances phraseology has been changed to preserve uniformity, without altering the meaning; and in two cases two separate resolutions have been consolidated and rewritten, preserving the original intention. Thus prepared, the result is herewith submitted for the action of the Association.

Instead of reading this report in full, which, as you can very well understand, is somewhat voluminous and could not well be followed, I take the liberty of submitting the following motion: I move that the report of the special committee upon codifying the resolutions and declarations of previous meetings of this Association be accepted and referred to the new executive committee, with instructions to edit the same, including the resolutions and declarations of this convention, and that the whole be printed and submitted to the next annual convention of the Association, with such recommendation as the committee sees fit to make in connection therewith.

Carried.

Mr. GOODELL. At the request of the Section on Entomology, I present the names of officers elected to serve during the ensuing year: A. D. Hopkins, of West Virginia, chairman, and M. V. Slingerland, of New York, secretary. I move their confirmation.

Carried.

Mr. GOODELL. I am instructed by the executive committee to offer the following resolution: "*Resolved*, That the dues for each college and each experiment station in this Association be fixed at $10 for the year 1897." I move its adoption.

Carried.

Mr. GOODELL. I also offer the following resolution, recommended for adoption by the executive committee:

(1) Inasmuch as a large amount of experiment station work has been reported since the Handbook of Experiment Station Work was issued, this Association would respectfully urge the Honorable Secretary of Agriculture to arrange for the preparation of a revised edition of this useful publication by the Office of Experiment Stations at an early day.

(2) Inasmuch as a large part of the work of the United States Department of Agriculture is along lines kindred to those of the experiment stations, it is deemed by this Association highly desirable that the revised edition of the handbook should include summaries of the work of the Department as well as of the stations.

(3) There is, in the judgment of this Association, great need of a general index of the publications of the Department, and as the preparation of such an index would almost necessarily precede the making of summaries of Department publications for the handbook, it is hoped it will be practicable for the Department to undertake at once the preparation of this index.

Adopted.

Mr. GEORGESON. I present the names of officers of the Section on Agriculture and Chemistry, as follows: Chairman, W. H. Jordan, of New York; vice-chairman, C. D. Woods, of Maine; secretary, H. J. Waters, of Missouri.

Confirmed.

Mr. EARLE. I present the names of officers of the Section on Horticulture and Botany, as follows: Chairman, P. H. Mell, of Alabama; secretary, L. C. Corbett, of West Virginia.

Confirmed.

Mr. DAVENPORT. I present the names of officers of the Section on College Work, as follows: Chairman, H. C. White, of Georgia; vice-chairman, A. W. Harris, of Maine; secretary, E. Davenport, of Illinois.

Confirmed.

Mr. STUBBS. I present the following resolution:

Resolved, That the executive committee be charged with the editing and publication of the proceedings of this convention, in cooperation with the United States Department of Agriculture.

Carried.

Mr. ATHERTON. Without going very much into an explanation and taking up the time of the Association, I move the appointment of a committee of three to revise the constitution of the Association and report at the next annual convention. There are various reasons for doing this which I have not the time to go into now, and some of which are not quite definitely formed in my own mind.

When the Association was first formed we were entering upon new and untried ground. The pendency of the Hatch Act was the first inspiration to the formation of an Association, and after the act had been passed it was deemed that this Association might do valuable work in connection with the stations established under it, and also in connection with the colleges of which the stations were branches.

The time has come, I think, for us to review the ground over which we have passed, and I move the appointment of a special committee of three to report upon the provision of the constitution, and, if possible, submit a draft of a revision at the next convention of the Association.

Carried.

The CHAIRMAN. I now announce the committee on revision of the constitution, as follows: J. H. Smart, H. E. Alvord, and the chairman of the executive committee.

Mr. EARLE. The Section on Horticulture and Botany wishes to report.

The attention of the Section on Horticulture and Botany was called to that portion of the report of the committee on uniformity in station nomenclature relating to horticultural terms; and, after some discussion, it was moved and carried to amend the last sentence in the definition of the term "acclimatization" by placing it in parenthesis and making it read "(the distinction between this term and acclimation is not generally carefully drawn, but acclimatization is preferred for scientific uses)."

As thus amended, the adoption of this portion of the report was recommended. The amended report of the committee on nomenclature is as follows:

RECOMMENDATIONS OF THE COMMITTEE ON UNIFORMITY IN STATION NOMENCLATURE.

The committee recommends:

(1) The adoption of the following by-law:

PROPOSED BY-LAW.

There shall be a standing committee of five on nomenclature. The director of the Office of Experiment Stations shall be ex officio a member of this committee, and the remaining four members shall be elected at the same time and in the same manner as other officers of the Association, and shall hold office for the same term. The committee shall elect its own chairman.

It shall be the duty of this committee to recommend to the Association such action as, in its judgment, will tend to promote uniformity and simplicity in the nomenclature used in station publications. Such recommendations shall be transmitted to the executive committee, and by it communicated to the director of each station at least thirty days before the annual convention.

In making such recommendations it shall be the duty of the committee to take into consideration any action by other organizations bearing on this subject, and to cooperate with such organizations, so far as practicable, in securing uniformity of usage between station workers and others in the same field.

(2) That the Association recommend to the several stations the uniform use of the following terms, with the significations appended:

A.—FIELD CROPS.

Maize (*Zea mais*).—Used when speaking of the plant in general.
Indian corn.—The grain of maize.
Corn forage.—The maize plant when fed without the removal of the ear.

Corn stover.—The maize plant after the ear has been removed.
Silo.—A structure in which green forage is preserved.
Silage.—Green forage preserved in a silo.
Siloing.—The process of preserving green forage in a silo.
Cultivation.—Stirring the soil by means of a cultivator.
Culture.—Refers to all methods by which a crop is improved or produced.
Tillage.—Stirring the soil by means of any implement for the purpose of growing a crop.

B.—BREEDS AND BREEDING.

Pure-bred.—(Not thoroughbred or full-blood.) Refers to the progeny of the members of a class of animals having like characteristics which are uniformly transmitted.
Grade.—An animal descending from common stock, but having more or less of the blood of some pure breed.
Cross, or cross-bred animal.—The direct cross of two pure-bred animals of different breeds.
Reversion.—(Not atavism, throwing back, or breeding back.) The process by which qualities are inherited from grandparents or more remote ancestors.

C.—FEEDING STUFFS.

[1] *Protein.*—(Not crude protein.) Total nitrogenous matter. Analytically, total nitrogen multiplied by 6.25 or other conventional factor.
[1] *Albuminoids.*—Coagulable nitrogenous matter. Analytically, albuminoid nitrogen multiplied by 6.25 or other conventional factor.
[1] *Nonalbuminoids.*—Noncoagulable nitrogenous matter. Analytically nonalbuminoid nitrogen multiplied by 6.25 or other conventional factor. (Should not be used to designate nonnitrogenous matters.)
Terms like "flesh formers," "tissue builders," and the like should only be used as explanatory terms.
Ether extract.—(Not fat or crude fat.) The material extracted from the dry feeding stuff by dry sulphuric ether.
Digestible fat.—The digestible portion of the ether extract.
Carbohydrates.—(Not carbhydrates.)
Fiber.—(Not "woody fiber" or cellulose.) The residue from the Weende method or its modifications.
Nitrogen-free extract.—(Not carbohydrates nor soluble carbohydrates.) Total dry matter minus ash, protein, fiber, and ether extract.
Digestible carbohydrates.—The sum of the digestible fiber and digestible nitrogen-free extract.
Pentosans.—(Not pentoses.) Total material yielding furfurol.
Individual substances in any of these groups should be designated by their scientific names.
The digestible portion of any of these groups should be designated by prefixing the word digestible to the proper name, as "digestible protein," "digestible albuminoids," "digestible fiber."
It is suggested that in tables for popular use the digestible fat be multiplied by 2.25, the digestible carbohydrates added, and the sum entered as "digestible carbohydrates and fat," the fact of the multiplication being explained in the text.

D.—ANIMAL CHEMISTRY AND PHYSIOLOGY.

[1] *Protein.*—Total nitrogenous matter.
[1] *Albuminoids.*—A collective term for albumen, globulin, fibrin, acid and alkali albuminates and other coagulable nitrogenous substances.
[1] *Collagens.*—A collective term for mucin, collagen, elastin, keratin and related bodies.
[1] *Proteid.*—Use only as an adjective; thus, proteid metabolism = the metabolism of protein.

E.—DAIRYING.

[1] *Protein.*—Total nitrogenous matter of dairy products.
[1] *Casein.*—The nitrogenous matter of milk coagulable by acids or rennet.
[1] *Albumen.*—The nitrogenous matter of milk coagulable by heat.
Curd.—The total precipitate produced in milk by the addition of acids or rennet.
Other nitrogenous matter should be designated by their scientific names.
Lactose.—(Not lactin.) The sugar of milk.

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[1] Recommitted for further consideration.

Fat.—(Not fats nor butter fat.) The glycerids of dairy products. When a distinction is to be made, as in case of oleomargarine or filled cheese, the term "butter fat" may be ussd.

[1] *Sterile.*—Free from all germs.

[1] *Sterilized.*—Sterilized products are those which have been heated to 100° C.; they are not necessarily germ free, although they may be.

[1] *Pasteurized.*—Pasteurized products are those which have been heated above the thermal death point of the vegetative organisms, but below the coagulating point of the albumen (60°–70° C.).

Pure culture.—A culture containing but a single organism.

Starter.—A culture of any nature used to start a fermentation.

Natural starter.—A starter prepared by the spontaneous fermentation of milk products.

Culture starter.—A starter made by introducing a pure culture into a pasteurized or sterilized milk product.

Acidity.—The acidity of dairy products should be expressed by the per cent of acid calculated as lactic acid.

F.—HORTICULTURE.

Acclimation.—The spontaneous or natural process of becoming, or the state or condition of being, inured or accustomed to a climate at first injurious.

Acclimatization.—Generally used in a more active sense than acclimation, as denoting the positive means or acts (as of man) in causing an organism to become inured to a climate. (The distinction between this term and acclimation is not generally carefully drawn, but acclimatization is preferred for scientific uses.)

Development.—The growth or life history of the individual.

Evolution.—The doctrine which supposes that one form of life may give rise to another form. The life history of the race.

G.—ENTOMOLOGY.

The committee recommends that the following general rules as to the adoption and use of common names for insects be adopted, but that action on specific cases be deferred to the next convention.

(1) No common name shall be applied to more than one species of insect.

(2) A single species of insect in any one stage of development shall have but one authoritative common name. It may have different common names for the different stages, e. g., apple worm and codling moth.

(3) When other than the authoritative name is used it should be made secondary in importance, e. g., the bollworm, also called "corn worm."

(4) Priority should be given due consideration, but should never be allowed to fix an inappropriate name on any species.

(5) As a rule, it is better to use a common name that will associate an insect with its food plant or host or with some well known habit or peculiar appearance of the insect. Twig girdler, bagworm, and saddle-back caterpillar are good examples of such names.

(6) The scientific name of an insect treated should always be given whether the common name is mentioned or not.

H. P. ARMSBY,
S. M. TRACY,
E. H. JENKINS,
THOS. F. HUNT,
C. P. GILLETTE,
Committee.

Mr. ARMSBY. I move that all definitions of the terms relating to the nitrogenous constituents of feeding stuffs, animals (and dairy products), be referred to the standing committee on nomenclature for further consideration, and that the remainder of this report, with the amendment proposed by the Section on Horticulture and Botany, be adopted.

Mr. PLUMB. A distinction is made between the terms "sterile" and "sterilized." I would like to have a statement made on that point.

Mr. ARMSBY. So far as the chairman of the committee is concerned, he can only state that these definitions were prepared by Dr. Babcock and were adopted by the committee exactly as he prepared them. As I understand it, the logical discrepancy

[1] Recommitted for further consideration.

was thought not to be so important as might appear on the face of it. If gentlemen think it desirable, I am perfectly willing to include this also.

Mr. PLUMB. Sterilized milk is not sterile milk.

Mr. SMITH. We use the word sterilized exactly in the sense adopted by this committee; but the word sterile, if used in the same way, will have to be applied to milk and sterilized milk will have to be called sterile milk if we are logical in our etymology. Sterilized milk means milk that has been heated to 100°

Mr. EARLE. Will everybody else use that word in the same sense? I think not. I therefore ask that the report be referred back to the committee. I think the word sterilize has been in scientific use too long to be tampered with and that a dairyman should manufacture a new name in order to meet the requirements.

Mr. PLUMB. I move that these terms be referred back to the committee.

Carried.

Mr. WASHBURN. The Section on Mechanic Arts nominates the following officers: Chairman, C. S. Murkland, of New Hampshire; Vice-chairman, W. F. M. Goss, of Indiana; Secretary, F. Paul Anderson, of Kentucky.

Confirmed.

Mr. WOODS. The committee on auditing has examined the accounts of the treasurer and reports as follows:

Your committee, appointed to audit the treasurer's accounts, begs leave to report that it has examined the same and finds them correct, with properly approved vouchers for each item of expenditure, and finds that there is a balance on hand of $475.45.

CHAS. D. WOODS,
C. FRANK ALLEN,
J. E. STUBBS,
Committee.

Accepted.

The CHAIRMAN. I appoint upon the committee to wait upon President-elect McKinley (see p. 31) G. W. Atherton, J. E. Stubbs, J. H. Smart, and H. H. Goodell.

Mr. ATHERTON. I am instructed by the committee to report the following resolution on the death of Hon. Edwin Willits:

Resolved, That this Association desires to place on record its deep sense of irreparable loss in the recent death of the Hon. Edwin Willits.

As one of the early and efficient promoters of the legislation out of which this Association grew, as one of its original members, and always the devoted advocate of the interests which it represents, as a public official of pure and stainless record, as an educator inspired with the highest ideals, as a citizen constantly engaged in efforts for the benefit of his fellow-men and striving to elevate the standard of civic life, as a gentleman of fine intelligence and unfailing courtesy, as a loyal and faithful friend, in fine, as a typical representative of complete and well-rounded American manhood he will always be enshrined in our loving remembrance.

Resolved, That this resolution be entered on the minutes of the Association and a copy sent to his surviving family.

By the committee.

GEO. W. ATHERTON.
ALEX. Q. HOLLADAY.
CLINTON D. SMITH.

Adopted.

The convention then adjourned sine die.

MINUTES OF THE SECTIONS.

SECTION ON COLLEGE WORK.

Two sessions of the Section on College Work were held in the parlors of the Ebbitt House November 10 and 11, the vice-chairman of the section, President J. E. Stubbs, of Nevada, presiding. The sessions were devoted entirely to papers and addresses on the question, "What should be taught in our colleges of agriculture?" and on "The exodus from the farm." The first address was delivered by G. T. Fairchild, of Kansas, as follows:

What Should be Taught in our Colleges of Agriculture?

In treating the subject "What should be taught in our agricultural colleges?" I shall make certain assumptions, without taking your time in argument to prove them. To me they seem fundamentally grounded in the object of these colleges, as stated in the organic act of 1862.

First. I assume that we are to aim directly at the inspiration and cultivation of scientific modes of thought in agriculture among the multitude. No mere expert training of the few can open to the industrial classes the liberal education promised and provided for by Congress. These colleges must attract the multitudes to their halls.

Second. It is safe to assume that the results of genuine research and experiment by highly trained experts must be accepted and utilized by a body of educated farmers sufficiently alive to the interests involved to appreciate principles and apply them with such modifications as sound understanding may require. The uneducated farmer asks for a rule of thumb, an explicit direction in detail; the educated farmer finds his rule for varying circumstances in the general principles established by research and experience. Unless the colleges of agriculture reach a considerable body of farmers with their liberalizing education there is little hope for a scientific agriculture.

Third. It is quite as evident that the moral and material support for scientific investigation of all phases of agriculture must come from such influences among the people, inspiring genuine desire for information. These fifty or more experiment stations will need the backing of a wide-awake, well-educated body of farmers in every State, or fail of support.

Fourth. I assume that the genuine experts for maintaining the rigid inquisition of nature must be found by the sifting process of a strong college course in line with agriculture. I see no other way of developing genuine talent and distributing it to the best effect than to draw into colleges a strong body of quickened minds, and eliminate the weak and uncertain by consistent training in the very lines of thought to be followed later. The experience of the past few years emphasizes the importance of the sifting process.

Fifth. It is safe to assume that any course which fulfills these requirements must be truly educational as well as instructive, and introductory rather than exhaustive. The training of human faculties to expert use requires a touch that recognizes all the phases of nature. Especially is this true in agriculture, where all of nature's laws must be obeyed to rule in any. To pour facts into memory will serve little purpose until the relations of facts are mastered by exacting scientific study in more than one direction.

To meet the conditions thus assumed, I propose plans that have already met a large measure of success in offering to the farmers' sons and daughters, fresh from their country schools, a general course of study in line with the industries of this life. It is absolutely essential that the way from the farm to the college shall not be interrupted. The city high schools do not and can not furnish the true line of training for the farm boy whose every sympathy is in the field and forest and farmyard. The trend of secondary schools is almost universally toward the need of the city in merchandise, manufactures, and professions. The inquisitive farm boy needs place for his natural development among the trees, grasses, crops, and herds, and machinery where all the great questions of his life are to be answered. The traditional curriculum has been the natural means of training in the use of books and the hand-

ling of men. The needed course must train in the handling of things and the use of nature, with books as mere tools.

To accomplish these ends of such a course of study, I would have a symmetrical development of body, mind, and sentiment along the most feasible lines of growth in my ideal farmer of liberal education. As fundamental in all study, a thorough training in the English language must stand first. If this is given through a comparison with other tongues I shall not complain, but the result must be English rather than linguistic information, or grammatical expertness.

For a good second in this liberal training I place an exacting study of mathematical principles and distinct applications of these in quantitive sciences like chemistry and physics. Form and quantity in all fundamental relations must be grasped as the basis of the universe.

The third essential is a symmetrical development of the descriptive sciences and the philosophies of organic life, as illustrated in all phases of plant and animal economy upon the farm. Soil culture in farm, orchard, and garden, the economy of farm machines, economic entomology, and vegetable and animal pathology must be so presented as to quicken the ingenuity of the student. Museum, class room, and library must display the riches of information open to inquisitive thinkers along these lines.

A fourth line of training should be in the arts of expression. To think and to express thought are essentially coincident and mutually dependent. Completeness of expression alone insures completeness of ideas. Hence all the definiteness that training in drawing—geometrical and free-hand—can give, should be coupled with good laboratory practice in all the sciences, and explicit training in composition and public address. I believe no better aid to exact thinking can be given than by training the voice to express by precise modulations the multitudinous phases of thought concealed in words.

Last, but not least, I put a training in manual dexterity, with the shop, the farm, the garden, and the greenhouse as the means. Nothing develops ingenuity and gives confidence equal to some form of manual training. The more general this is in developing dexterity rather than limited skill, the better education it gives for scientific agriculture for either profit or investigation. The more continuous it is, the more perfect the habit of devising and doing becomes.

Such a course I can give in outline without departing far from the tested curriculum of the Kansas State Agricultural College. I will try to present it in such form as to show progress along the five lines of training:

A course of instruction in agriculture.

FIRST YEAR.

English, etc. The sentence. Composition. Etymology.	Mathematics, etc. Algebra. Algebra. Algebra.	Sciences. Botany. Bookkeeping. Elementary physics.	Expression. Free-hand drawing. Geometrical drawing. Physical laboratory. Rhetoricals and drill.	Dexterity. Woodwork. Woodwork. Garden or farm.

SECOND YEAR.

Principles of horticulture. Descriptive agriculture. Dairy farming.	Geometry, plane. Geometry, solid. Geometry, descriptive.	Inorganic chemistry. Organic chemistry; Mineralogy. Entomology.	Chemical laboratory. Blowpiping. Chemical analysis. Rhetoricals and drill.	Garden or farm. Iron forging. Farm and garden.

THIRD YEAR.

General history. Civics. Rhetoric.	Trigonometry. Mechanics. Economics.	Physiology. Zoology. Agricultural chemistry.	Surveying. Topography. Perspective. Rhetoricals.	Farm and garden. Iron foundry. Farm or garden.

FOURTH YEAR.

English literature. Psychology. Logic.	Advanced physics. Advanced physics. Engineering.	Agriculture. Feeding and breeding. Animal economy. Geology.	Sketching. Botanical laboratory. Thesis. Rhetoricals.	Farm or garden. Machine shop. Specialty.

This course of four strong years rightly leads to the degree of bachelor of science, and is worthy the name for subject-matter as well as manner of training. From the numbers thus trained there will be a few whose bent of mind and love of research direct into definite lines of investigation. For these a variety of strong post-graduate courses of two or three years should be provided with the master's degree at the end conferred for original work carefully presented in a thesis. My preference is that such a course, in our colleges of agriculture, should couple the science pursued with one of the arts illustrating its economic applications. It thus gains a technical character most conducive to energy of purpose and action. The Kansas college in this way couples botany or entomology with horticulture, and chemistry or zoology with agriculture. The interest and the meaning of both are thus enhanced.

These students, in technical courses, should have every encouragement and aid in the use of literature of their science, through whatever language it comes. Comparatively little time is needed to gather the elements of a foreign grammar needed to read with understanding any book in a science already familiar, and with this object directly in view a student learns with surprising ease.

In conclusion, I emphasize again the importance of so adjusting the studies in an agricultural college as to give a liberal education of body, mind, and sentiment in tune with the end to be served—a genuinely scientific agriculture and a body of agricultural science.

The next paper on the same subject was presented by H. H. Goodell, of Massachusetts, as follows:

In an old book containing the wisdom of an age two thousand years older than the present I find this quotation: "How can he get wisdom that holdeth the plow and that glorieth in the goad, that driveth oxen and is occupied in their labors, and whose talk is of bullocks?"

Apparently the same need of instruction was as urgent then as now, and the tiller of the soil in the fertile plains of the eastern world felt there was something more to be desired than simply following day in, day out, the dreary routine his fathers had left him. That there were sources of information even then is evident from the fact that the wise Solomon could discourse of trees, from the cedar of Lebanon even to the hyssop springing out of the wall; and it is added that he spake also of beasts, of fowls, of creeping things, and of fishes. The same questions that stirred the heart of the agricultural seer so many centuries ago are pressing with renewed force now, and more light is sought on all the difficult problems that present themselves to the farmer of to-day. It is the mission of the agricultural colleges to furnish this light and lead the way.

I am asked to present this afternoon a brief paper on what should be taught in our agricultural colleges. Perhaps I can express myself in no way more clearly than by outlining to you the course at the Massachusetts Agricultural College. That has stood ever since its foundation, in 1867, for agriculture alone, instruction in the mechanic arts being supplied by the Institute of Technology, which has shared with it the proceeds of the grant of 1862 and the later one of 1890.

While it has been the purpose of the faculty to give the best possible instruction upon every subject taught, there has been no effort to expand the course beyond the proper limits of a simple professional school or to compete in any manner with other existing institutions. On the other hand, the college has from the outset been intended to be something very different from a mere manual-labor or farm school for training apprentices in the various operations of husbandry. Since the first few years manual labor has been entirely discarded, except in so far as it has an educational value—not how to plow and hoe, but when and where to do it to the best advantage. The hours of student life can be much more profitably employed than in mere manual labor, opportunities for which are everywhere presented, while the facilities for education are offered only at the college and for a limited period. More mind and less muscle is the watchword of to-day. In preparing the soil, in planting, in cultivating, in haying, in harvesting, in threshing, in the management of the dairy, in fact almost everywhere, intelligence is the principal thing, and mere brute force comparatively worthless. The old prejudice against thoughtful, studious, and progressive men as book farmers and fancy farmers has at length been overcome by the mass of printed matter which is flooding with light every household and by the numberless improvements which have been demonstrated to be not merely expensive luxuries for the rich, but of priceless value to every tiller of the soil. But to turn more directly to the curriculum itself.

This naturally divides itself into seven departments—the English, the agricultural, the chemical, the botanical, the mathematical, the zoological, and that of languages and social science.

(1) English has a place in the curriculum of the Massachusetts Agricultural College because of its practical value and its educational value.

By its practical value we mean its value in enabling the student to express his thought by oral and written language. Looking at the study from this point of

view, we may name it the study of oral and written expression. The specific subjects and exercises set for securing this practical advantage from the study are these: Rhetoric, during the freshman year; declamations, during freshman and sophomore years; essays, in the freshman, sophomore, and senior years; orations in the junior year; logic and debates, in the senior year. The principal object in these exercises is to secure accuracy and facility in the use of the English language as an instrument by which thought is expressed.

In addition to these studies, American literature is studied in the sophomore year and English literature in the junior and senior years. While, as an incidental advantage, the student's style in writing and speaking may be improved and perfected by reading and studying the best works of the best authors, literature is studied chiefly for its educational value. As literature is one means by which the thoughts and aspirations of men are expressed, one can learn the history and progress of the thought of the American and English people from the study of American and English literature. The student's mind being thus brought in contact with the great minds that have adorned the pages of English and American history, his powers are quickened and developed thereby, his mental horizon is enlarged, and thus a most important educational advantage is secured.

(2) The agricultural course covers a field of such wide and varied extent that it is hard to compass it in a four-years' course. The graduates must know the origin and nature of soils and subsoils, and the proper treatment of each; the methods and advantages of the various kinds of tillage, and the modes of drainage and irrigation, with their cost and value. They must understand the worth and peculiar effect of every variety of mineral and organic fertilizers; the construction and use of all the implements and machines of improved husbandry; the best modes of planting, cultivating, and harvesting all sorts of crops, and the varieties of each which are most valuable for different localities and objects. They must be familiar with the characteristics of the different breeds of domestic animals and their various adaptations; with the proper modes of feeding for particular purposes, and of treatment in health and sickness, and with the principles of breeding. They must be acquainted with the keeping of farm accounts, the ordinary rules of business, and the legal rights and obligations of landholders; with the renovation of worn-out lands and the improvement of those which are new and rough; with the most desirable location and construction of farm buildings, the correct division of an estate into arable, pasture, meadow, and woodland, according to circumstances, and the building of roads, bridges, and fences. They must understand the use of rotation in crops; the management of the dairy; the cultivation of vegetables in the market garden and under glass; the raising of small fruits and their transportation and sale; the planting and culture of vineyards, orchards, and forest trees, and the theory and practice of landscape gardening, with the proper selection and treatment of ornamental plants. The strictly agricultural part of this course is carried on for eight terms, mostly by lecture, embracing the following topics: The history of agriculture, soils, drainage, irrigation, disposal of sewage, fertilizers, field crops, implements, breeds and breeding, dairy farming, cattle feeding, laboratory, and experimental work. The horticultural work covers six terms under the following heads: Horticulture, market gardening, landscape gardening, floriculture, sylviculture, care of greenhouses, and construction.

(3) The course in chemistry extends over nine terms, the last three of which are almost entirely laboratory work, eight hours per week. Commencing with lectures and practice in elementary chemistry, there follow in succession dry and humid qualitative analysis, lectures and practice in organic chemistry, chemical physics, and quantitative analysis. In connection with this is a series of lectures on the application of chemistry to the industries of life.

(4) Botany covers seven terms, embracing structural, analytical, economic with laboratory work, cryptogamic, and physiological. The course aims to treat of all the more important features connected with the study of plants which have a close bearing upon agriculture without at the same time deviating from a systematic and logical plan. Throughout the entire course the objective methods of teaching are followed, and the student is constantly furnished with an abundance of plant material for practical study, together with an elaborate series of preserved specimens for illustration and comparison. In the freshman year the study of structural and systematic botany is pursued, with some observation on insect fertilization. This is followed in the first term of the sophomore year by the systematic study of grasses, trees, and shrubs, and this during the winter term by an investigation into the microscopic structure of the plant. The senior year is given up entirely to cryptogamic and physiological botany.

(5) The mathematical course. In this day of scientific experiment, observation, and research on the farm, the advantages of a thorough knowledge of the more elementary branches of mathematics, general physics, and engineering must be more than ever apparent; and it is to meet the needs of the agricultural college student in these lines that the work in the mathematical department has been planned.

The mathematics of the freshman, sophomore, and junior years are required; those of the senior year elective. The sequence of subjects is as follows: Bookkeeping, algebra, geometry, and mechanical drawing in the freshman year; trigonometry, mechanical drawing, and plane surveying—the latter embracing lectures and field work in elementary engineering, the use of instruments, computation of areas, leveling, etc.—in the sophomore year: general physics—including mechanics, electricity, sound, light, and heat—and descriptive geometry or advanced mechanical drawing in the junior year; and, finally, two electives in the senior year, mathematics and engineering, respectively.

The mathematical option includes the following subjects: Fall term, plane analytic geometry, embracing a study of the equations and properties of the point, line, and circle and of the parabola, ellipse, and hyperbola; winter term, differential calculus, and summer term, integral calculus.

The senior engineering option is designed to give to the student the necessary engineering training to enable him to take up and apply, on the lines of landscape engineering and the development of property, his knowledge of agriculture, forestry, botany, and horticulture. It embraces a course of lectures, recitations, and field work on the following subjects: Topography, railroad curves, earthwork, construction and maintenance of roads, waterworks and sewerage systems, etc.

The engineering elective is intended to equip the student to enter a comparatively new field—that of landscape engineering, which is coming more and more prominently before the public attention; for with the increasing consideration which is being paid to the public health and the development and beautifying of our towns and cities come fresh needs and opportunities.

(6) The zoological course commences with one term of anatomy and physiology, followed by a term of laboratory work eight hours per week, in which each student is required to make dissections, use the microscope, and make drawings of his work. This is followed by one term of zoology, three of veterinary science, and four of entomology, the last three being optional, consisting largely of microscopic work and drawing eight hours per week.

(7) The seventh and last course embraces the modern languages, French and German, political economy, constitutional history, and a course of lectures on rural law, including the rights and obligations of landholders, and other subjects of practical importance to every citizen, whatsoever his profession.

I have now sketched more or less in detail the seven divisions of our agricultural courses. It is for three years rigid and defined, with liberty to select and specialize in the fourth. The structure is reared somewhat after this fashion: Agriculture the foundation; botany, chemistry, zoology, and mathematics the four corner stones, while the walls are solidly built up with English, horticulture, floriculture, and forestry on the one side; English, physiology, entomology, comparative anatomy of the domestic animals and veterinary on the other; English, mechanics, physics, and civil engineering on the third, and English, French, German, political economy, and constitutional history on the fourth. The study of the English is made the basis of all study. It is interwoven with every course. It is, in fact, the very warp and woof of every branch pursued. These seven courses, each distinct in itself, yet each aiding in the interpretation or solution of the difficult problems met with, require a four years' course. They proceed hand in hand, and the completion of a study in one department is coincident with that in another. Mutual help is the watchword. Each for all, but all for each, in laying broad and deep the foundation and building up the solid structure. Thus when the relations of the weather—of heat, air, moisture—to farming are considered, on the botanical side are being studied the structure of the plant—its organs, the relation of its root system to soil and moisture; on the chemical, the elements important in an agricultural point of view and their properties; and in the mathematical, such algebra and geometry as will lead on to practical work in surveying and drainage. So, too, when soils and tillage are under consideration, in like manner are studied plants beneficial or injurious to man, general geology, and those insects hurtful or otherwise to the crops. In short, the effort is made to have each course supplement and be in harmony with the other, and the different studies so fit into each other as to make one rounded whole.

H. J. Waters, of Missouri, read the following paper on the first subject:

It is perhaps one of the most fortunate circumstances connected with the creation of the agricultural colleges of the nation that the act of Congress bringing them into existence was broad and comprehensive enough with respect to their purposes and objects to admit of the teaching of a wide range of subjects. This was especially fortunate when it is considered that a large number of these institutions were to be brought into existence within a very short time, to be officered by men without special training and experience in teaching the branches of science directly relating to the industrial pursuits, and brought into existence at a time when industrial or technical education in America had scarcely begun.

The comprehensive charter with which each institution was vested at its birth permitted a reasonable amount of experimentation in the arrangement of courses of study, in methods of instruction, etc. This experimentation has proven invaluable in many ways. Then, too, this broad plane has given the greatest liberty of adaptation of courses of study to the peculiar needs of the different States of the Union. For example, a State having large mining interests would naturally find it most profitable to develop her system of technical education along the lines of mining engineering more rapidly and fully, relative to the other lines of work, than would be justifiable of a State whose agricultural interests largely predominated and whose mining interests were comparatively unimportant.

It is clear, therefore, that no definite scheme of studies equally applicable to the needs and requirements of all States and to the peculiarities of the public and high school system of the different States can be laid down. Nor is it, in my judgment, possible, except within very wide and general limits, to say what shall be and what shall not be taught in our agricultural colleges.

By the terms of the act we are compelled to admit that the leading object of these institutions is to teach such branches of learning as are related to agriculture and mechanic arts. And while express permission is given for the teaching of the classics, it is clear that they are not to constitute the leading object. In other words, the teaching of principles and the applications of the sciences to the useful arts is mandatory, while teaching the general culture studies embraced in the classics is entirely optional.

In the first place, it is held that the intention of the act was to establish and maintain colleges, and that the instruction should be of college grade. Within this limit it is further held that any subject directly relating to and promotive of any important industrial interest of any State may be properly taught by the land-grant college of the State, provided that in addition to its being useful it shall at the same time be in the highest degree educational. (The major proposition is intended to be inclusive, but not entirely exclusive.) Its converse, viz, that no subject not directly fulfilling these requirements is eligible to a place in the curriculum of any agricultural college is not necessarily true.

It appears to me to be a matter for each college to determine for itself whether it will attempt to take cognizance of all the important industrial interests or concentrate its efforts and funds upon a few of the more prominent ones. As to whether a given college shall offer courses in agriculture, mechanical, mining, civil, or electrical engineering, and domestic economy, or require all its students to pursue one course embracing the leading educational and industrial features contemplated in the law, should be left to the properly constituted authorities of that college to determine.

The general policy of the institutions with reference to the proportion of cultural and technical subjects offered in a course designed to cover a given industry is a proper subject for discussion by this body. By the letter of the law there is no restriction as to what these cultural subjects shall embrace—whether the classics, modern languages, psychology, or what not. While it is agreed upon every hand that in all cases provisions should be made in all courses for a reasonable amount of instruction that tends toward liberal culture, it is equally clear that the technical, the industrial, the useful instruction (those sciences relating to the several industrial pursuits) shall constitute the majors, in order that the training there imparted may be directed to some practical end. But it is insisted that our colleges of agriculture shall be broadened, that the training shall be more liberal. Let this broadening be in the direction of an increased number of distinctively technical courses of study, rather than in the introduction of a wider range of subjects in the courses themselves. Let each course be as severely technical as possible. Let agriculture constitute the chief and important subject in the course in agriculture, just as is law the essential element in a course in law, just as is medicine in the course in medicine. Let it be a professional course to fit the student to become a successful farmer, or a teacher or investigator of some branch of agriculture. Not in the teaching of agriculture alone should this rule apply, but to all courses maintained by the funds derived from the land-grant act and the acts supplementary thereto.

That such courses will not have a high educational value is denied. Until these colleges are able to turn out young men who can and will conduct the ordinary operations of a farm or garden, dairy or orchard more successfully than young men of similar ability who have not had the advantage of such training, the advisability, profitableness, and economy of an agricultural education will be problematical in the minds of the farmers. So long as the colleges are unable to demonstrate their usefulness to the farmer beyond a shadow of a doubt, so long will the general public rightfully question their value. So also the graduates from the engineering courses should be able to demonstrate by their lives and by their successes along the lines of their training that the expenditure of time and money in acquiring that education was a profitable investment. These results can not be secured with any degree of certainty so long as the courses of study are designed with reference alone to the

discipline of the mind, and the acquisition of useful facts is overlooked entirely or made a mere incident.

The arrangement of the courses in engineering with reference to the character of the instruction and the methods of imparting it, with reference to the proportion of nontechnical or cultural instruction to technical, has been quite generally agreed upon. A glance at the schemes of studies of the engineering courses will reveal a general similarity, indicating an approximately unanimous judgment of the teachers in these courses and of the framers of them.

An examination of the courses in agriculture, however, convinces us that a large amount of experimenting in this line is yet being indulged in by our colleges. There is not that similarity in composition, in arrangement of studies, already noted in the engineering courses. Contrasting two courses in agriculture representing the extremes in these regards, we have required for graduation in the four years' course in College A, 49.9 per cent general culture, 24.6 per cent nontechnical scientific, and 25.4 per cent technical; College B, 8.1 per cent general culture, 39.3 per cent nontechnical scientific, and 52.6 per cent technical. That is to say, that in College A 49.9 per cent of the student's time is devoted to general culture subjects, such as English, mathematics, history, political economy, etc., 24.6 per cent of the total hours required for graduation is given to the study of sciences more or less related to agriculture, and but 25.4 per cent of his time is given to the study of the application of these sciences, to the successful pursuit of agriculture, and to a study of the art and practice of agriculture.

In College B these percentages are, as stated above, 8.1 per cent general culture, 39.3 per cent nontechnical scientific, and 52.6 per cent technical. These two colleges represent two important agricultural States in the Union; their requirements for admission are not essentially different; the public and high school systems of the two States are quite similar, and presumably about equally developed, and, finally, the agriculture of these two States does not differ materially. Yet the policies of these colleges are as strongly opposed one to the other as they could well be when attempting to accomplish the same purpose. Each college claims a prominent place in the front ranks of agricultural educators, and points to its courses of study as evidence of the correctness of the claim.

A majority of the colleges of the country have made their courses a happy medium between these extremes, approximately as follows: General culture, 24; nontechnical scientific, 46; and technical, 30.

Although one prominent college included in the average requires but 18 per cent of technical work, the proportion of technical work required in their courses in agriculture by these more conservative colleges does not compare with the amount insisted upon in the engineering, medical, law, and other professional courses. It is insisted from the outset that the course in agriculture is a professional course, and as such this profession for which it purposes to fit men is of prime importance.

But what of the training for citizenship in this course is instantly demanded? I answer, what of the citizen engineer, what of the citizen physician, what of the citizen minister? Is the farmer as a citizen expected to play a more important part than the engineers educated by our land-grant colleges? Is he less likely to have acquired under the parental roof, in the public schools, the same amount of patriotism, the same amount of knowledge of the proper administration of governmental affairs, than is the student who goes into any other of the professional courses? Is the student in agriculture less likely to acquire that knowledge necessary for the highest duties of citizenship upon his own motive and in his experience in college and in after life than are other professional men? It is believed that all of these questions carry their own negative answers.

The following paper on the subject was read by H. C. White, of Georgia:

I am asked to discuss, in a short paper, the subject "What should be taught in our colleges of agriculture?" The use of the possessive pronoun in the title somewhat limits or at least gives definiteness to the range of the discussion. The question, I take it, is not "What should be taught in a college of agriculture?" but rather "What should be taught in the colleges whose representatives are brought together in this Association?" The distinction is important in its bearing upon the discussion in hand. In order to determine what should be taught therein it is proper to inquire what a college of agriculture is or should be. Assuming agriculture to be a distinct profession or pursuit in which men are to engage who are specifically and technically trained to that end, I can very well understand that there might be a college or school of agriculture as there are colleges or schools of medicine, law, theology, engineering, music, art, and other so-called professions. In such event the college of agriculture, in determining what and how it should teach, could probably do no better than to follow closely the example set by these other professional schools in the character and scope of the teaching which they offer and upon which they have determined after long years of experience and

historic development. I think it is true that the primary function of these schools is the teaching of the great body of rules of practice or procedure in the several professions, with incidental exposition of the scientific or dogmatic principles upon which the rules are based. It is acquiescence in these rules, indeed, which is professed; the recognition of their reasonableness and soundness which give character to and uniformity in the tenets of the profession. Now, in order that such teaching may not be the mere inculcation of blind empiricism, these institutions take for granted (at least the best of them do and all of them should) that their matriculates have already been educated—have had their store of general information, their powers of observation, and their faculties of reasoning already developed by the educative processes of the school, the academy, and the college. Law, medicine, theology, etc., are "learned professions," not so much because the pursuit of them necessarily develops learning, but because, properly, only those should engage in them who are already "learned," in the sense that they are truly educated and so equipped that they are properly prepared to acquire increasing learning with increasing years.

The schools which teach these professions are, in fact (or should be), technical training schools in specific lines. They are not truly, except incidentally, educational institutions at all. So, perhaps, should be a true "college of agriculture." Now I do not say that the practice of "agriculture" may not eventually be (or, indeed, is not now, for that matter) competent of exposition in a code of general rules of procedure such as those which are accepted as at the basis of the practice of law, medicine, or theology. But I think we must all admit, at least, that as yet these rules have not been framed to what our distinguished friend, Dr. Harris, so aptly characterizes as a "pedagogic form." As yet they have not been so systematized as to come within the province of the teacher. So long as this is true, therefore, in the sense which I have endeavored to convey, a genuine "college of agriculture" is, perhaps, without existence or the possibility thereof.

Undoubtedly it is extremely desirable that this great industrial art, the practice of which in these latter days has become indeed worthy to rank as a learned profession by reason of the manifold applications possible therein of the great stores of learning achieved in many of the branches of human investigation and research—particularly in the physical sciences—should speedily have its rules of procedure reduced to such form as will bring them within the legitimate domain of the "pedagogue"—he who "leads the children" to think and act aright in all the works of their heads and hands. We who form this Association are perhaps of all men those most interested to that end. One object of this immediate discussion, no doubt, is to elicit an exchange of opinion upon that subject.

Waiving this point for the moment, however, and turning to consideration of "our" colleges, what is it that should be taught in them?

As most clearly setting forth the objects and character of these institutions, I will be pardoned for quoting the familiar text of the laws establishing them, which I do, not merely to state their provisions, but also to approve heartily thereof. Each of them is a college—not an academy or a school; its function "to promote the liberal and practical education of the industrial classes;" its "leading object · · · to teach such branches of learning as are related to agriculture and the mechanic arts · · · without excluding other scientific and classical studies;" and each is under obligation to devote a portion of its revenues to giving "instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their applications in the industries of life." The quotation of the law in this discussion concerning what we should teach in our colleges is pertinent because where its requirements are specific we are bound, as honest men, to observe them. Were they all specific and explicit there would be no need of this discussion. What we desire to arrive at is an interpretation of the general requirements of the law and a course of procedure which shall best fulfill its spirit and intent.

Dealing first, then, with the injunctions which are specific, our institutions are to be educational establishments, not professional schools. They are to contribute to the drawing out and direction of the intellectual powers of the youth of the land—particularly of the "industrial classes"—so that they may be properly fitted by "liberal and practical" culture to engage in the "several pursuits and professions in life."

They are colleges, and this designation helps us to determination of the stage in the educational process where our work should properly and profitably begin. With the differing conditions surrounding the institutions in different localities it is obvious that no fixed and uniform regulation can be laid down upon this point. The subject of entrance requirements to colleges generally—in what topics and to what degree—is engaging the earnest and systematic attention of educators in other associations similar to our own. Excellent ideals are set, to which it is sincerely hoped we may all be ultimately enabled to attain, uniformly, in all parts of our common

country. As yet, however, this is manifestly not practicable. Time may make it possible. So far as "our" institutions are concerned, I think we might properly and safely demand of applicants for admission thereto that they should exhibit the same or equivalent measure of acquirement (in "liberal" culture, at least) and intellectual development as is required by other collegiate institutions in the same or similar localities. Our teaching should begin at a corresponding stage.

While upon this point permit me to indulge in a few reflections of a general nature which are yet pertinent to this discussion:

(1) Obviously, there is no warrant, in law or reason, for the distinctive designation of our colleges as "agricultural" or "mechanical." I think it is a pity that the habit has grown among us. "Land-grant," or "State," or "science," would be more fitting appellations if distinctiveness is desired. "Agricultural experiment station" is an eminently proper name for our stations; it indicates just what they are; "agricultural" or "mechanical" prefixed to our colleges is unwarranted, to say the least, and is likely to be misleading.

(2) I think it unfortunate that the word "classes" occurs in the Federal act of endowment. There should be no "classes" known to the law in this Republic; surely we should recognize none in the construction of our schemes of education.

(3) If, as we believe (otherwise our professions are a deceit and our occupation a fraud), the proper, acceptable, and successful prosecution of the great industrial pursuits—agriculture, the mechanic arts, and other—demand an education and a degree of culture (both "liberal" and "practical") no whit less thorough and no lower in order than is required for engagement in other pursuits, we should take care that nothing which we set forth in the curricula of our colleges shall be a confession of the weakness of our faith or be capable of construction into an admission that our education develops less able thinkers, less worthy men, less competent leaders of their fellows, or leads to less honorable or dignified pursuits than that which is furnished by other collegiate institutions. We should never forget that our colleges are one important fruit of the memorable conflict, actively begun a half century ago and waged and won within our generation, between science and dogma for the recognition of the study of the physical sciences as a legitimate and necessary factor in genuine education. They were born of this conflict, the victory in which was a triumph of modern enlightenment over ancient narrowness, a decision that new elements should be introduced into our educative processes, not to supplant but to reenforce the old, that the two together might contribute to the formation of a completer man. The successors of the victors would woefully misapply the fruits of the victory if the institutions which they set up should deliberately embrace the very errors which were combated to give them life and exhibit a narrowness and one-sidedness in their curricula which, although of opposite tendency, would be no less fatal to the development of the perfect man than that which in the older institutions was condemned.

The laws creating our colleges not only permit us to guard against this danger; they enjoin us so to do. The provisions of the law are in accordance with the wise and reasonable views on the subject of education which guided the conflict referred to to its successful termination. Efficient hewers of wood and drawers of water and skillful artisans there were in abundance before the blessed enactment of 1862. This was not designed to add to their numbers or perpetuate their guilds. It was intended to increase the learning of the youth of the land, to furnish them with intellectual powers and stores of knowledge especially applicable in the industrial pursuits by providing liberally for education to that end, in order that those who might engage in such pursuits should no longer be mere slaves of a craft, but freemen in the intelligent prosecution of their chosen handiwork.

The specific subjects enjoined by the law to be taught are:

(1) Military tactics. As a lover of peace and of all agencies in the body politic which conduce thereto, I should be inclined, individually, to say "more's the pity:" but as we have it to do, let us do it thoroughly and well; not necessarily to the extent of placing our students under military discipline, which, personally, I deprecate for many cogent reasons, but as efficiently, consonant with its peculiar character, as we propose to instruct in other branches embraced in the curriculum.

(2) Agriculture and the mechanic arts. Let me waive discussion of these for the moment.

The nonspecific injunctions of the law are certainly general enough to weigh upon the conscience of no man who is a wise educator. They should be so, for obviously differing conditions in revenue, locality, character of students, and other circumstances will make necessary differences in the curricula of the colleges, both in the number of branches taught and in the relative importance assigned them. "Branches of learning related to agriculture and the mechanic arts;" "without excluding other scientific and classical studies;" "the various branches of mathematical, physical, natural, and economic science." Surely, so far as the letter of the law is concerned, the strictest constructionist could not assert that anything having the faintest

shadow of a claim to be considered a branch of education might not be taught in our colleges.

The great purpose of our colleges may be gathered from both the letter and the spirit of the law. It is to furnish a "liberal and practical education," suitable for those who may be expected to engage in industrial pursuits. Without entering into discussion (which would be interminable) of what is or may be meant by the "liberal" and the "practical" in education, I think we all recognize that there are certain great groups of studies which differ somewhat in their educative purposes and methods, although their ultimate aim is the same, and it is not always easy to determine for a given study to which group it more particularly belongs—the one devoted mainly to redecraft, the other to handcraft; the one dealing mainly with the mind, the other with the sense; the one characterized sometimes as "literary," the other as "scientific." Both are necessary in judicious education. Our colleges are called upon to furnish both, but this does not mean that they are to exhaust the field in either direction or to be uniform in the branches which they adopt or in the relative importance they may assign to them. I venture to say that, personally, I should consider certain branches as universally essential, each to be pursued to the extent commonly covered by a college course. These are, in redecraft, the English language and literature, mathematics, psychology; in handcraft, the physical sciences, physics, chemistry, biology; with regular and ample laboratory work in each. To these fundamentals it is possible and may be desirable to make many additions on either hand. In rede-culture, the classical and foreign languages, history, economics, moral science; in handcraft, subdivisions of the physical sciences to any extent which may be practicable or desirable—mineralogy, geology, workshop mechanics, and the elements of technology in various lines. The pedagogic value of these differ with differing circumstances, and each college should carefully determine for itself those best suited to its special conditions. One thing, however, I think should constantly be borne in mind in the conduct of this, the truly educational work of the colleges. In teaching the "branches of learning related to agriculture and the mechanic arts," we should make it clearly appear that they are so related. In the liberal culture given by study of the masterpieces of our English tongue, for example, selections might readily and preferably be made to show that correct speaking and writing, a pleasing style in composition and expression, adherence to the rules of rhetoric, and even, perhaps, a touch of the breath of poetic inspiration, are as becoming and necessary in one who speaks and writes of the industrial occupations of the people as of him who declaims of their rights and liberties upon the stump or discusses their political problems in the columns of the press. The evolution of civilization presented by the study of history may be as well, if not better, shown by emphasizing the part played therein by peaceful industries as by recountal of battles and sieges and the lineage of kings. Patriotism may be inculcated no less through proper pride excited by the industrial achievements of our country in its times of peace than by panegyric of its glories won in times of war. Illustrations necessary to demonstrate natural laws in science may be taken from the myriad examples furnished upon the farm, in the field, and in the workshop, which will serve at least equally as well the purposes of pure science as those arranged artificially in the laboratories or on the lecture table. Where differentiation is found possible, moreover, in the physical sciences, those branches should be selected which relate most directly to industrial pursuits; provided, always, that a proper pedagogic method is afforded and a genuine scientific spirit be maintained. Soil physics, agricultural chemistry, botany, entomology, animal nutrition, economic geology, may serve for truly educative purposes as furnishing illustrations of principles in the study of the pure sciences, physics, chemistry, and biology.

In fine, while it is not necessary, nor is it proper, that we should erect our colleges into unreasoning partisans of the industrial arts as in antagonism with other pursuits, yet we should make manifest to our students, by illustrations drawn therefrom in our educative processes, by the teachings of history, and by exhibition of their proper and legitimate fruits, that through them lies a path to usefulness and happiness at least equal in stability and dignity to those offered by other occupations or professions.

So much for the educational work of our colleges. What shall we say to the injunction to teach agriculture and the mechanic arts? How far may we go and in what manner to make our colleges, in part, training schools in distinct pursuits? This, I take it, is the point of most interest in the present discussion.

First, then, as to agriculture. While my opinions are merely tentative, and I can not be said to have reached positive convictions on the subject, notwithstanding a fair acquaintance with what is being done in this particular at home and abroad, I am inclined to think, at present, that the school of agriculture should be a school of demonstration, not of attempted education. The professor of agriculture (if there be one) should teach neither physics nor chemistry, nor biology, nor engineering, nor any parts thereof, under the titles of soil physics, agricultural chemistry,

stock breeding, farm surveying, and the like. He should rather demonstrate the applications of the previously taught principles of pure science in the operations of the farm. The school of agriculture should be provided with a suitable farm, including orchards, garden, and dairy, each equipped in the best manner possible with proper buildings, stock, cattle, and machinery, and each should be conducted regularly and systematically as a model of its kind in illustration of the proper and best methods of actual practice in the several branches of agricultural industry. The students of the college should be admitted to witness, and, if need be, to take part in the operations, and the demonstrator in each should be competent and required to give explanation of the processes and the reasoning underlying them. It can readily be seen that the number of these processes may be very great, including preparation and tillage of land, drainage, irrigation, feeding and care of stock, breeding of cattle, vegetable and fruit culture, butter and cheese making, the housing, preparation, and marketing of farm products, and a great number of others. The point I particularly make is that these operations should be illustrative, and in every case performed in the very best manner that science and experience direct. The school of agriculture should be the clinic of the college. In a manner it should bear the same relation to the college that the hospital bears to the college of medicine. It should be primarily designed for those who have already received, or are at the same time receiving, the educative culture of the college proper, and it should not undertake to duplicate or infringe upon the pedagogic work of the college. This may seem unnecessary to say, but perhaps it is not so so long as it not infrequently happens that a "professor of agriculture" conceives it his duty to give lecture-room instruction to his classes in smatterings of botany, agricultural chemistry, vegetable and animal physiology, and other such topics which properly belong to the departments of the several special physical sciences, where they can be taught much better and with a proper regard to the period in the student's education where they should be introduced, and since the most of our text-books on so-called "agriculture" follow the same general plan in their treatment of the subject. So far as these text-books are concerned, perhaps it is not possible to follow any other plan, since the practice of agriculture can only be taught by actual demonstration. When what they do is well done, as is the case in the admirable little manual of our friend Professor Voorhees, these books serve a most useful purpose, but should not be taken as exemplifying the course to be given by the professors of agriculture in our colleges. Although certain of the topics which I have mentioned may in strictness be considered of the nature of applied rather than of pure science, they are in the main such as should enter into the education of any man of liberal culture, and should not be estimated as the peculiar possession of those only who propose entering the industrial pursuits.

Again, this illustrative work and training of the college farm and its attachments should be distinct from the research work, in its several lines, of the experiment station. It is, unquestionably, eminently advantageous and desirable that the station should be intimately associated with the college, particularly for the sake of the station, but for sake of the college as well. For that matter, an investigator in one might very well be (and preferably) a teacher in the other, and advanced or graduate students of the college might be admitted to participation in the researches of the station; but the work in each should be distinct, and while they should cooperate and aid each other whenever possible, the distinctive purposes and functions of each should be carefully discriminated. In connection with this technical training in handcraft, instruction might properly be given in the school of agriculture, in farm management and economics, in the history of agriculture in all its branches, and in the systematic and critical study of agricultural literature.

Instruction in the mechanic arts, I take it, should follow the same general lines, the workshops taking the place of the farm.

Now, I am aware that I have mapped out an amount of work for our colleges which is stupendous. Either the educative work or the illustrative work is alone very great; the entirety—to us of small means, especially—is simply appalling It will rarely, perhaps never happen, that any of our colleges can do it all; but I submit that it might be wise to follow the general policy which is herein outlined. Let each college do what it can, and make its selections among the lines of work offered according to its means and the conditions surrounding it. Upon certain points I should be inclined in all cases to insist:

(1) That our colleges should be colleges in fact as well as in name. They should be educational institutions in higher learning, in which the physical sciences particularly should fill their proper and important place as educative branches. They should be true colleges, requiring, on the one hand, of those admitted to them a certain proper degree of previous education, and on the other stopping short of the specialization in distinct branches which constitutes, in the pure sciences, the proper work of the university, and in certain of the applied sciences of the experiment stations.

(2) That they should provide the necessary and proper amount of this educational work first of all and should never permit themselves to become the nurseries of unlettered craftsmen in the industrial arts, however skillful. This need not, necessarily, exclude from certain of the technical courses those who are seeking information rather than education, but care should be taken that the chief function of the college is educational, not informational.

Where the land-grant college subsists exclusively upon its Federal revenues it must, perforce, be modest in its aspirations. Should other collegiate institutions exist in the community with which it may cooperate, so that it may require of those admitted to it a previous reasonable degree of college education, then its work may legitimately be chiefly given over to the demonstrative teaching which I have indicated. Best of all, perhaps, is the arrangement, when it is feasible, of such intimate and local association with other collegiate institutions as will provide for the educative and leave the bulk of the revenues of the college available for the technical demonstrative work. Such an arrangement as—my friend Professor Bailey will permit me to say—is so ably administered at Cornell University, in the State of New York, for example, certainly leaves nothing to be desired. I am quite well aware that "many men, many minds," and that an arrangement of a given character which might be admirable in one locality and under one set of conditions might not work well in another locality and under different circumstances. I am discussing the question purely from an ideal standpoint.

In any event, whatever may be the conditions, rede-craft (in its best and thorough signification) should precede, or at least accompany, hand-craft, however thorough this may be. Our colleges must give such good, genuine, broad education to their students as will equip them with the mentality requisite to cope successfully with their fellows in the intellectual struggles of life, or else they fail of their purpose, become a laughingstock of scholars, and a hurt rather than a blessing to the community. In no other way, in my judgment, can our colleges serve the great purpose for which they were founded—to make of the industrial pursuits intellectual occupations to be engaged in by educated men.

The first paper on the exodus from the farm was presented by I. P. Roberts, of New York, as follows:

THE EXODUS FROM THE FARM: WHAT ARE ITS CAUSES AND WHAT CAN THE COLLEGES OF AGRICULTURE DO TO NOURISH A HEARTY SENTIMENT FOR RURAL LIFE?

During the last quarter of a century farm machinery, inventive genius, and new discoveries of various kinds have made it possible for one man to produce four times as much of many farm products as formerly. If a greater per cent of the farm boys did not find some other occupation than that of their fathers, it is evident that there would not be employment for all unless some new and extended market was found for surplus products.

We live in an age of specialties. Work has been divided and subdivided until occupations are so numerous that almost anyone can find a calling well suited to his tastes and training. Formerly many farmers' sons remained on the farm because there was no appropriate calling for them outside of farm life. The result has been that a large per cent of those who now occupy land are not adapted to their calling.

The law of "the survival of the fittest" up to the present time has not been operative among agriculturists. It has been truthfully said that anybody could farm; that was, but is no longer true. When the soil was fresh and soft and rich, and required the minimum of skill and effort to secure crops, those most unfitted for rural occupations could easily secure a competence and even a surplus. But all this is changed.

Competition in agriculture, as in other things, has become severe, and he who does not have a liking for and understand his profession must, sooner or later, find employment with and be directed by those who either naturally or by training are better fitted to battle with the more difficult conditions which surround us. From this time on, the law of "the survival of the fittest" will prevail in agriculture.

The whole course of our Federal policy toward public lands has tended to produce a race of soil robbers, not farmers, and sooner or later in all civilized countries the robber pays the penalty of the broken law. From 1861 to 1865 vast numbers of men changed from producers to consumers, and prices of farm products became abnormally high when measured by inflated currency. These conditions could not fail to mislead and disappoint many when population and currency were restored to normal conditions.

Soon after 1865 there were added to the farming community, in addition to a vast influx of foreigners, many soldiers who saw in the high prices then prevailing quick and large returns from the rich lands which had been opened to settlers by the construction of extended systems of railways.

From 1870 to 1880 the percentage of increase of new farms was 50.71 per cent, while the increase percentage of population was but 30.8 per cent. During the decade 1880 to 1890 the increase of new farms was 13.86 per cent and the increase in population was 24.86 per cent.

During the war times inventive genius not only so improved the appliances of agriculture as to quadruple the productive power of each farm, but it also, through improved steam transportation, brought the products of several foreign countries into sharp competition with our own exportable farm products. This could have but one result—overproduction, which invariably ends in prices so low as to preclude the possibility of profit.

The farm boy was not less able to feel the forces that modified his life than other boys, although he was not able to analyze them. He saw railroads being constructed, shops of every kind going up, buildings increasing at an unheard-of rate, and he also saw that the men engaged in these lines of activity received a much larger remuneration than did the tillers of the soil. He was not to blame for these conditions. Neither he nor his father perceived that in certain lines of industry there was unusual activity or a great demand, while in other lines there was overproduction and hence small remuneration. Instead of blaming the country lad for seeking these more remunerative positions, I have the highest respect for his shrewdness and good judgment in availing himself of them.

He saw, or should have seen, that three-fourths of the labor formerly required for harvesting the millions of acres of crops annually raised was being performed in the cities. The construction of binders, mowers, harvesting machines, steam thrashers, improved harrows, and sulky plows gave full and remunerative employment to men who formerly worked in the field, while the labor of many a farm boy was no longer required in the field to raise or glean the harvest of the United States.

The exodus from the farm was inevitable and justified, and the result eventually will be a race of farmers who not only like rural life, but who are well fitted to pursue it profitably. There are now many who occupy the land who must, of necessity, leave it, since neither by nature nor by training are they adapted to their vocation, and the sooner they leave their unprofitable occupation and enter into something that is more remunerative, and the sooner trained and cultivated farmers own and till the land, the better it will be for all concerned.

In order to discover the boys who are naturally fitted for rural affairs and train them for their life work, more "sifting" must be done at an early period of their lives. This naturally begins in the rural school districts. Here must be taught the simpler principles of the natural sciences. Here must be discovered the likes and dislikes of the farmers' children. No one would think of trying to educate a child for an expert musician who had neither ear nor taste for music If we can determine the natural trend of a child of 10 to 15 years of age, while yet in school, in the direction of sound and tune, may we not also discover it in other directions at this early age? If, then, agriculture in its broadest sense is to be taught in the district schools, there must be teachers—living teachers, for books are worth little in the hands of children without a trained mind present to explain, interpret, and apply the thing taught.

While something can be done by traveling teachers and by institutes if the work is well and thoroughly done, trained teachers must be provided, and here is a legitimate work of the colleges. We should not lay less stress upon training the farmers, but far more upon training teachers for the district, the village, and the high schools.

To nourish a healthy sentiment for rural life, some of the mysteries of rural life must be known. To know a flower, how it grows and how it feeds, is to love it. By teaching the elementary sciences as applied to agriculture in the secondary schools throughout the country pupils may be "sifted" much earlier than at present. The tastes of each may be determined. One must go to the city, because if retained on the farm he would be a failure, while another will naturally develop the tastes and abilities which go to make the successful farmer.

We have fallen upon strange times, unusual conditions—such conditions as have never been before in all the history of civilized nations. Formerly most of the national and individual effort was to secure food and clothing. In our day we have more food than all the people can eat, we have more clothing than the people can wear, and we are forced, from these peculiar circumstances, to let our fields lie idle, abandon them to the growth of weed and briers, and to pull the fires from the boilers and stop the wheels of manufacturers.

It seems to me that the problem reaches far back of what appears on the face. It is difficult to solve, and I hesitate even to make a recommendation as to what would be wise to do, yet I fully believe that a supply slightly less than is needed is far better than an oversupply of products which can not be stored or saved without loss for future generations. If the working classes—and by this I mean nine hundred and ninety-nine out of every thousand able-bodied American citizens—could be content to work six, or at most eight, hours per day and devote the balance of their time to acquiring knowledge and to recreation, we should then not have a glutted

market, intermittent labor, and the ills which immediately follow when a large number of men are overworked, or, still worse, when a large number find employment for only a portion of the year at high wages, and are left unemployed, either mentally or physically, for longer or shorter periods.

If, somehow, we could get clear of the grasping, sordid, money-getting spirit which is so prevalent in all America, and learn to prize highly leisure, wisdom, and knowledge, the problem of low prices, overproduction, and exodus from a healthy rural life would be measurably solved,

The following paper on the second subject was read by E. Davenport of Illinois:

Thoughtful men have become alarmed in recent years at a seeming disposition to abandon the land and move to town, and so general and pronounced has this migratory movement seemed, that it has been called the "modern exodus."

Because of the economic questions involved, every effort should be put forth to understand this exodus; and because the colleges of agriculture are institutions particularly charged with the interests of rural people, it is eminently fitting that these matters receive careful attention here.

The following paper does not pretend to completeness, nor was it written from the larger views of the economist. It simply recites some personal observations and the convictions that have been forced upon me by intimate contact with farmers and a somewhat careful study of their needs.

We may well ask ourselves some questions: Has the exodus been overestimated? What are the causes that draw men from their farms? What classes of people are involved? Is the principle of selection affecting the quality of country residents, and how? Will a man leave the land as soon as he is educated? Are the conditions of life improving in the country as rapidly as in the city? Is land becoming relatively less remunerative? Are farms becoming larger? Who owns them? If they are rented, where are the owners? What are they doing? And why are they not living upon their possessions? Is the tenant system extending and what are its effects?

Space forbids an attempt to answer all these questions, if indeed an answer is possible. Questions connected with the impulses and movements of a great people are often too complex and subtle to yield to analysis or to be explained by reasoning. However, certain considerations stand out clearly in the perspective.

First of all, let us not be deceived by its seeming magnitude. That our population is increasing more rapidly in the city than in the country, is not to be taken as conclusive evidence of a growing desire for city life, because agrarian population appears first in order of development. Manufactures, commerce, and cities await the accumulation of wealth from the products of the soil. Again, there are natural limits to country population, while no bounds are set to the multiplication of towns, the extension of city limits, or the density of urban population; so that at any time after the pioneer period each succeeding census will likely show an increased proportion of city population indicating a movement from the country. Considering the wealth of our people, the activity of her business interests, and the rapidity with which her history is making, we are to expect an extensive and pronounced migration to the city, which might seem like an exodus and still be normal.

It should stand out clearly in the mind at the outset that though the movement is pronounced, this is not so much a question of numbers as of quality. There is small danger of our lands being deserted and rendered unproductive, as witness the wild rush at the opening of each of the few remaining reservations, when men, women, and little children stand for days in rain and slush awaiting the signal to cross the border—the last hope to own land. Land has not so generally decreased in price when measured by a true standard of value as is commonly believed, and yet remains practically out of reach of poor people. The query is not so much how many, but who are going to town? Is the principle of selection one that is operating to elevate or to degrade the country people? This is the question upon which will turn the future condition of the American farmer, and possibly the fate of a government by the people. This question is not to be solved by statistics showing mere magnitude of movement, but rather by a minute study of the real and the alleged causes that contribute to the results, together with their inevitable consequences. Without a doubt this exodus has been considered quantitatively and vastly overestimated. It has not been much, considered qualitatively, and has therefore been underestimated.

Through a long and intimate acquaintance with farmers I have sought diligently for the reasons that draw them from their farms, and these are the ones given me by the people themselves:

The family goes to town to educate the children; because of the difficulty of securing competent help; on account of the excessive burdens upon the housewife; to retire from business, or to establish a son upon the farm. All but the last lead to renting, so that in point of fact the land changes hands and loses in the transaction the benefit of careful oversight. The last is no part of the exodus, because a

natural successor is installed, but all go to swell the city census and to contribute to the numerical effect. The young man's separation from the farm comes about, according to his own statement, from a desire for an education, an impulse to see the world, a belief that the city offers more and better opportunities for advancement, or, as he may frankly admit, because he does not "like" the farm.

Now, these are the reasons by which the individual supposes himself to be actuated. That they are not always the real causes I have abundant reason to believe. For example, I have often heard farmers insist that the business does not "pay," but I do not remember ever to have heard one give that as his reason for leaving the farm. Farm life in certain families is so meager as to fall upon a really noble nature like a blighting curse, yet I never heard a young man put that fact into words as fitting his own case.

Again, many of the alleged reasons are the fruit of impulse, not the settled convictions of judgment. They are often at variance with fact, and commonly the individual acts in face of the utmost ignorance of the new conditions among which he proposes to place himself. From this we must conclude that the exciting cause is often unsuspected by the farmer himself, and that the subtle forces that actuate should be sought beneath the reasons given. They must be sought in the conditions that surround the farm, and the effect of these conditions upon its revenue and upon the hearts and the minds of its people.

It seems a paradox to say that profitable farming has contributed to this movement, but such is the undoubted fact. In certain favored sections farming has been exceedingly profitable on lands secured at a nominal figure, and many a family has retired and is living in comfort on the rental of landed property accumulated in less than half a lifetime. This fact is largely responsible for introducing the tenant system into America and ingrafting a species of serfdom upon our free institutions. So has prosperous agriculture contributed to her own degradation.

It must not be overlooked that rural life and affairs have been influenced by exceedingly peculiar circumstances during the last two or three decades. This period, which has been one of general prosperity, has borne heavily upon the farm, because of the opening of the boundless West. Here was half a continent peopled from the rural population of the other half, rendering labor scarce and costly and at the same time flooding the markets with grain and animals cheaply produced at the expense of virgin fertility. This has rendered farming on older, more valuable, and often better lands, for the time unprofitable, and few realize what this withering competition has really been, and none but a careful student or the sufferer himself appreciates the unequal fight against virgin fertility.

Besides all this, the same period has witnessed the greatest activity in business enterprise and inventive genius along mechanical lines that the world has ever known. So vast have been the undertakings and so rapid the changes as to create an imperative demand for a high degree of technical skill. Even mediocrity, if coupled with faithfulness, has been well, even extravagantly, recompensed. The countinghouse, the shops, and the great lines of transportation have demanded and received the best attainable ability, and it has all drawn heavily upon the farm.

In all this period of general prosperity the farmer and his farm have suffered the severest competition in two directions at the same time, the one aimed at himself and the other at his business—a draft upon the most ambitious young men for skilled service in new and fascinating lines, and a subtraction from the people to develop the great West, throwing back upon Eastern agriculture a burden of cheap products to cancel her efforts and eat up her substance like the self-digestion of the stomach after death. We have overdone the matter of development, and the wonder is that American agriculture has endured so well. The production of a million miles of the best land on earth suddenly thrown upon the world contemporaneously with the opening of the Suez Canal and the development of India! Nothing like it was ever done before, and it came near paralyzing the agriculture of the w rld.

But this combined competition from within and from without is passing. We have witnessed the practical exhaustion of the public domain. Population has pushed too far into the "Great American Desert" and is retreating, and the best energy of the virgin fertility of half a continent has spent itself. The skilled mechanical occupations that have been so attractive are establishing among their people a competition that is most pitiless. Schools have been organized to fit young men to win positions, and already an applicant must show previous training and render the most faithful service. Not only that, an age limit is being set. A locomotive engineer will find difficulty in securing a new position after he is 35 years old, and one of our great lines has set the age limit for firemen at 26. None of the skilled professions are merciful to their employees, nor can they be, for if a new device comes in requiring fewer men or skill of a different kind, the old operatives are retired. The worst of this competition is over, and I personally know of young men having taken technical courses and afterwards coming to the conclusion that landed property is in the end most valuable.

The growth of our free-school system has been phenomenal. We would not have it otherwise. It was organized upon a geographical basis, but it is rapidly becoming organized upon a municipal plan, and farmers may well mourn in sackcloth and ashes at the passing of the district school, and with it the possibility of the township high school.

Of all the factors involved in the present discussion, the most widespread and the most pernicious in its consequences is the "moving to town to educate the children." Such a condition of things is anomalous. The people are neither farmers nor citizens. Upon the change of residence family idleness succeeds habits of industry and thrift, and the children by inference establish a conviction that there is some natural connection between an easy life and living in town. They do not know, or if they know do not realize, that the family has ceased acquiring; that it is in a business sense "marking time" for their benefit. They learn to look upon this new existence as the normal condition of city life, and they love it as all children prefer indolence to industry. They have lost their touch with nature and have but a few conjugations to show for it.

These inferential sentiments upon the part of the child are encouraged by his studies. During all his school years he is removed from contact with rural affairs and for the most part with all nature. His mental activities are directed along abstract lines. His training is extremely intellectual and devoid of the industrial idea, or else it is technical, as fitting him for a "position." In either case he is unfitted rather than equipped for rural life. Coming as he has from intimate contact with nature and with material things, it is not strange that he suffers a kind of mental atrophy as he passes from the natural to the artificial; from the great school of observation and experience to the narrow field of what he with his small wisdom is able to draw from books.

Many a naturally broad minded, deep thinker has been spoiled in educating, and while erudition is to be respected above most things, the best educators have detected this inherent weakness in a system of education that does not educate, and under various names and by various methods are getting back to nature. When the newer school of pedagogy shall have impressed itself upon our schools, the whole trend of education will not be so strongly away from rural life.

No subject is of more importance here than the growth of the tenant system. It is at first a consequence, but once established, it becomes a prolific cause of evil that is insidious and far-reaching. It robs the land of that careful oversight that is its due; it tends to impoverishment of soil, lessened productiveness, and a failing revenue. It discourages improvement and removes the impulse and the occasion for rural adornment and landscape beauty. It is incompatible with the home instinct which is the chief excellence of rural surroundings. Renting divides with another the results of effort. Carried ahead a few generations this may only mean that one man pays rent to another because his grandfather was less shrewd.

A further evil attends the tenant system, and that is its effect upon country schools. After the landowner moves to town, he is forced by taxation or by tuition to contribute to the support of the schools that he proposes now to patronize. He meets many unexpected expenses incident to city life to which he has hitherto been a stranger, and he acquires habits of parsimony. He is no longer interested in the district school; on the contrary he will, from motives of economy, oppose it, for he can not see why he should support a school in which he has now no interest. The renter can not stand for good schools because he pays but little tax and his activity in this direction is considered an unfriendly act toward the landlord. This condition of affairs carried to its limits simply defeats the primary object of the free-school system and provides the worst possible education for the children of the tenant. Instances are not wanting in which the tenant has not been able to renew his contract because of his influence in the matter of school expense.

In so far as the social instinct accounts for this exodus, it is largely outside of the better class. We shall always have those who need the stimulus of numbers or of excitement to induce activity. These will drift naturally to the city. As light substances float where the eddies are strongest, so this lighter element of humanity will always constitute the flotsam and the jetsam of city life. It is not the highest, but the lowest or the weakest type of man that needs this stimulus to effort. The farmer's is not a solitary life unless he makes it so. The social instinct in man is no explanation of the drifting of the better class into the cities, and if it is true that our best young men and women are demanding the city life because of the excitement and the entertainment, then something is wrong with our system of perpetuating the American race.

I come now to what in my judgment is the most potent influence in draining the best young people from the farm. I refer to that caricature of humanity that passes for a farmer in the pages of current literature. Simple minded, and incidentally honest, uncouth in language and coarse in manner, destitute of everything but good intentions, he is depicted more unfavorably than is positive villainy. A creature of

the imagination, a composite of everything comical, is made to represent one-half of a great people. His very name is fixed, and his horse's name is Dobbin. As his biographer warms to his task he rises to the supreme of ridicule and his very words are systematically misspelled. Then, when all other means are exhausted, as a last and telling effort, this typical farmer is contrasted, not with the average, but with the most favored citizen. The two extremes of man, the farmer and the dude, have been so definitely and so unfavorably portrayed as to be well on the road to extinction. The fruit of all this is that country towns put on city airs; that clerks and small tradesmen rank themselves above the farmer and affect airs with his family.

So it has come about that odium has attached to the land and its occupants. Why, no man knoweth. Like other occupations, farming has its disagreeable features; but sensible people of all callings understand the significance of agriculture, respect the people engaged in it. Certain gentlemen of leisure, thoughtlessly forgetting that there is any connection between the food that keeps them alive and this same calling and people they caricature are doing a great wrong to the American farmer. True it is that farming was once the occupation of slaves; but as the English people and their language were more impressed by the Saxon serf than by his Norman conqueror, so is the natural advantage with the soil and her people. If we drive the American citizen from the farm he will rent it to the foreigner; but if Americans are to control America they must keep possession of the land. If I have spent much time upon this point it is because I regard it as an insidious evil which, being laughed at, goes unpunished and unrebuked, and because I firmly believe it is doing more to permanently depopulate our lands of good people than all other causes combined.

What can our colleges do? From their name and nature they owe a definite duty to the community, to the soil, and to the individuals that own it.

Economists would prevent the overdevelopment of a dependent class and preserve an homogeneous population. City societies for relieving distress among the poor would return the surplus to the soil. We shall side with the economists. We can not endure the loss of the best and the return of the worst. We want a cultured rural class, not a peasantry. The colleges must take high ground in the matter and reestablish a standard of refinement and culture so nobly typified in the old-fashioned country gentleman.

Our people are undergoing a trial in this transition period of our great country. The situation is many sided. Hitherto the colleges have contented themselves with technical instruction. They have a broader work. They must attack the whole problem, or they will come short of their duty and forfeit their prerogative.

The business side of farming needs attention. The calling must be fairly profitable or a cultured people will not develop on the land or remain if they do develop. The fertility of our lands, which is our capital, is gradually but surely disappearing. We are selling our birthright piece by piece. Methods looking to the economizing of fertility and to the increase of the productive capacity of the soil are almost unknown or unheeded by the general farmer. We persist in pioneer methods after pioneer conditions are passed, and the individual grows discouraged when old-time practices yield a constantly decreasing revenue.

The remedy for all this is more knowledge of the right sort. George T. Powell, speaking before the New York Society for Improving the Condition of the Poor concerning the question of the causes of agricultural depression in the State of New York, said that a noticeably higher degree of prosperity and contentment was found in the vicinity of Cornell University, and that it was by the people themselves attributed to the influence of the Experiment Station. He further observed that graduates of the college of agriculture over the State were so many centers of better methods and better feeling. The cumulative influence of forty colleges and experiment stations will tell ere another decade has passed, for the people are beginning to have confidence in these institutions

Our farmers need to know how to pass from the extensive agriculture of pioneer conditions to the more protective and intensive methods necessary to sustain production on older lands. They need to know that this change should be made gradually, not suddenly; and that it should be most active in periods of prosperity, because high farming is no remedy for low prices. The ten-hour day should be introduced upon the farm as securing better habits of labor and greater results, together with more comfort to the laborer. Labor should be employed throughout the year. Even if for a month or two it is unprofitable it will pay in the end, for the best labor will seek constant employment. When discharged at the beginning of the most trying season, the winter, it is but natural to look for employment in the city where seasonal influences are supposed not to operate.

The waste on most farms from loss of fertility, from labor ill bestowed, from abuse of machinery, and from unprofitable animals in debt to their owner and their food would constitute a fair profit. Our colleges and stations are learning the drift of general principles. They must discover methods and practices that are ultimately

safe; and learning these they must teach them in season and out of season to student and practitioner, to the end that waste of fertility, of goods, or of energy be prevented, and that the rural class remain prosperous, cultured, and happy.

There is a domestic side. In the city the home life and the business life are entirely divided. It is not so in the country. It is fortunate for the children that they are thrown in daily contact with the business side of life. To that is due the superior stability of the country boy. But the business should not invade the home. There should be times and seasons in the farm home when business topics are tabooed. No day should pass but that the home life as a thing of happiness should be directly stimulated. The library, the periodicals, the games and amusements must each receive attention from the standpoint of rural life, and the colleges ought to lead in the matter.

Now that architects have turned their attention to the designing of moderate-priced cottages, those home comforts, known under the name of modern conveniences, are to come into our country homes. A bathroom costs less than a new carriage, but a crown awaits that architect who will design a really convenient kitchen.

There is an esthetic side. Home adornment and landscape beauty are the cheapest sources of that placid contentment that conspires to morality and strength of character. The first steps in this direction would generally be the firing of a wilderness of rubbish or the destruction of a forest of weeds. I passed, the other day, a house in a natural paradise, but horribly disfigured by the accumulation of the various accidents of human occupancy. Swinging from a post was a new patent gate. It subserved no evident purpose, for it was the only visible "sufficient barrier," yet it cost more money than would have sufficed to restore the reign of nature and to transform the insufferably ugly spot into a veritable Eden—a home. Why, then, was it not done? It was not from want of money, but want of artistic instinct. A few trees, a little fresh, clean sod, a few curved lines, and the thing is done. An individuality is attached to that spot, and there is home. The colleges must labor for this directly.

There is an economic side. The natural advantages of ownership of land are not appreciated. The family living is seldom entered to the credit of the farm. "I raised that" is considered sufficient, and not until the farmer comes to pay city bills for table expenses does the sometime farmer realize what he eats. The country boy is deceived by the sound of city salaries. He has not known money in large amounts. The results with which he is most familiar are expressed in bushels or in pounds. What is in excess of family needs makes its way into dollars from time to time, but unless he keeps accounts he does not realize the yearly footing. The salary is expressed in gross yearly totals, and the supposed difference amazes him. He does not know that most city positions win a living and nothing more. He does not know that as the country grows older salaries will grow smaller instead of larger. He does not know that even a skilled occupation may be suddenly destroyed by some new invention, and the employee "relieved" in middle life, but at an age too advanced to permit the learning of a new trade equally remunerative. He does not know that when he is too old or too feeble to sit at his table daily, his land will still labor for him, because he has established in company with it a business. He does not realize that a man on a salary is simply hired out; that he does not establish a business, but must retire when he can no longer render regular personal service. He does not know the cumulative value of land when held in a family for a few generations, nor the advantage it gives. The young man and the young woman must be taught these things, and the colleges of agriculture must do it. It has been taken for granted that these courses are to train dependent young men for valuable service in landed enterprise. There could not be a more fatal error. Somebody owns the soils of these United States, and these courses are to train their sons and daughters to a proper appreciation of the natural advantages they possess.

There is a sentimental side; and it needs a further word. The ridiculous foolishness that caricatures this calling and this people will pass. But our young men and women have no proper standard of what is genuine success. In the books written for their edification, all the characters achieve phenomenal success. This is intended to encourage and stimulate effort. It succeeds in setting up before them a standard ordinarily impossible of achievement. All that they read is cast in the superlative. What they see is nearer normal, but in the halo of their enthusiasm common things and ordinary people and their successes look insignificant and mean. The true value of the success that ordinary people may attain by the severest exertion needs magnifying mightily, and our colleges must do it. This is vital to the success of rural life. Not many will be Presidents, not many will startle the world, and our young men need to know better than they do that no intellectual pearls will be buried even in the wild solitude of the farm.

There is an educational side. Would that some genius arise and prepare a series of common-school text-books, in which the spirit of nature should breathe

through every sentence and every word. Would that our normal schools were fitting in greater numbers teachers that could see in the surroundings of the schoolhouse a great laboratory of living things and that would begin to build an education upon a knowledge of these things as a foundation. Of how many trees or plants does the child learn the names, uses, or relationships? Of how many of the animals about him does the child in school learn the habits? What use is made of the fauna, the flora, or the geography of the neighborhood? When will the teacher lead the little child into the activity of the great living world about him? The colleges can hasten the day if they will.

Last of all we need a new definition for an agricultural course. Let it be this: A broad and liberal education from the standpoint of rural life and its affairs. Let its object be the fitting of the children of American farmers for the duties of life in a free republic. Let it be in part intensely technical, but let it include also the sciences, history, economics, the humanities, if you will, but only let it be stimulating.

The colleges of agriculture must consider these questions. They have no choice in the matter. On them is the burden of the education of that great middle class the rural people, without whose independence, stability, and character a free government may not hope to succeed. On these oconomic considerations must courses of study be arranged and educational policies established.

If I have had a purpose in preparing this paper, it is to bespeak a higher standing for the American farmer and a more liberal and a more fitting education for his children.

SECTION ON AGRICULTURE AND CHEMISTRY.

The sessions of the Section on Agriculture and Chemistry were held in Grand Army Hall during the afternoons of November 10, 11, and 12, C. C. Georgeson, presiding.

The first paper was presented by H. A. Huston, as follows:

Chemistry for Technical and Practical Students.

In the suggestions that follow it is assumed that the student is one who intends to make chemistry his life work. The field is large and the subject is constantly becoming more divided into specialties. With this comes the temptation to begin the differentiation process at too early a stage in the student's development.

Foundations for technical work.—The first essential for the technical student is the ability to really read English. This statement may seem so simple as to be uncalled for here, but it is a fact that many students enter our technical institutions who can say the words before them, but who do not really grasp the full meaning of any but the very simplest statements, and frequently do not get the full relations of even these.

It is all very well to say that these defects are to be attended to by the much-abused instructors in English; yet, if you expect your students to get the most from reading or lectures, it is your duty to find out whether the students have a good working knowledge of the means of communication; and if they do not, put them in the way of getting it. The desirability of a working knowledge of German and French will be admitted.

Paradoxical as it may perhaps appear, the foundation of technical chemistry is a good working knowledge of the principles of physics. No inconsiderable part of the chemist's work consists of purely physical operations and measurements. The chemical student who can determine the working conditions of his balance, check up his weights, his graduated ware, and his thermometers, determine a specific heat, generate and control an electric current, reduce gas volumes, and who has a working knowledge of optical instruments, has a tremendous advantage over one who must do these things by rule of thumb or take them on trust, and who must one day stop in the midst of professional work to train himself in some or all of them.

The student must know the principles of chemistry—the fundamental laws—and at least enough chemical facts to illustrate and fix these laws in his mind. This knowledge is derived from the book, the laboratory, and the lecture. The three sources are given different degrees of prominence by different institutions. Even at the risk of appearing at variance with most teachers, I am of the opinion that the so-called lecture is given too much prominence and the good old hard grind on the book too little. I am now speaking of elementary instruction. The young instructor, fresh from his European studies, is especially liable to overdue the lecture. What is the nature of the work? The instructor makes an abstract from several standard works, combining fundamental laws, illustrative facts, attractive novelties, and perhaps startling paradoxes, and presents the medley to the best of his ability, while performing before his class experiments too elaborate to be performed by the student at the laboratory desk. This lecture is in turn abstracted by the student to the best of his ability while watching a series of complicated experiments, rewritten, read, and blue penciled by the instructor, and perhaps again written over by the student.

All this requires a great outlay of time and I expect you are familiar with the value of the final product—the student's note book. For it is generally in his book, not in his head. I believe the time could have been better spent by a careful study and discussion of a good text book and enough laboratory work of simple character to give the student an opportunity to test the statements of the text book and to acquire some skill in manipulation.

At this stage it seems to me that lecture work should be confined to experimental demonstration of the fundamental facts, and its purpose should be to supplement the text-book and laboratory work by such experiments as can not be well performed by the student, and by such as the instructor may think necessary to add to direct especial attention to the more important principles.

The student can not learn too soon that his text-book does not contain all there is of the science. Standard works of reference and journals should be accessible, and he should at least be made familiar with the general character of these works in order that he may know where to look for fuller statements of facts when occasion may require.

The quantitative relations of the science should be early insisted upon, and enough of the student's laboratory work should be made quantitative to give him confidence that his equations and the numerical results of them have a substantial basis in facts. It is not uncommon to find students, after several years study, really deficient in chemical arithmetic.

Training analysts.—When the more important principles of the science are learned we turn to the analytical side of the subject. There is no danger that anyone will become too good a qualitative analyst. The probability is very much in the other direction, and I think that one reason for it is that too little attention is paid to the principles at the base of all analytical operations. And right here again is the place for the good solid grind with the book. Not one of the multitude of covers with more or less intelligible tables between them, but a good solid study of the real facts, physical and chemical, on which chemical separations are based. Here we want both the how and the why; the method and the reason for it. In the quantitative work seek accuracy first, speed will come in time. In quantitative work there are a good number of determinations that every analyst is very likely to need, and these are very properly made the basis of the quantitative course. The number of subjects must depend largely upon the available time. But one purpose should be kept steadily in view—to give the student confidence in this work. To this end, substances of known composition, not necessarily chemically pure salts, should alone be used until this confidence is established.

From this on the quantitative work should be directed to giving training in subjects most likely to be useful and to promote the student's ability to adapt himself to varying work. For this last nothing is more valuable than to acquire the habit of carefully studying and rigidly following working directions of a few new methods. When the student comes to take his place in a technical laboratory he must of necessity use many special forms of apparatus and methods peculiar to that particular business, and here his adaptability will count.

Development of technical sense.—As soon as the student is qualified to begin work on technical products of variable composition the necessity for training his technical sense arises. He must be taught to use his head, to bring common sense to bear on the operations associated with the purely chemical work. Here belong the subjects of methods of securing representative samples from materials in all sorts of condition, the question of what substances are important enough to require quantitative determination, the choice of the analytical method best suited to the purpose, the question of what refinements in analysis the method of sampling and the requirements of the work will justify, the question of allowable differences between duplicates, the significance of a given variation in percentage, the allowable working error, which is a very variable quantity with different materials, and, finally, the ability to interpret properly and present clearly the results of his work.

In the development of this technical sense visits of inspection to industrial plants are valuable. Lectures by specialists in given fields are most profitable as sources of information not otherwise obtainable, broadening the view and stimulating the student to make some field of work his own. Thrice fortunate is he who is under an instructor who is a specialist and who combines relations with an industrial plant with his teaching. There is no better way for the student to get in touch with the commercial relations of his training than association with such instructors.

Capacity to conduct investigations.—When the student has his analytical tools well in hand and his technical sense somewhat developed he may undertake original investigation. There is a tendency among young instructors to put students at work on what is sometimes called "organic manufacturing" long before they are competent analysts. Older instructors are not blameless if their own zeal in original work leads them to use student aid as soon as the student can do furnace work, and at a period of the student's development when he ought to continue systematic analytical work.

I fully appreciate the great scientific and technical advancement due to the development of organic research. But too many young men, after leaving the organic laboratory, have spent years in hitching a molecule of something to the outermost fragment of the wreck of a benzol ring—work interesting to the former instructor, perhaps, adding a new fact to our knowledge, but narrowing the horizon of the worker at the very time he ought to be expending it.

It is better to put a student on a very simple investigation of his own than to associate him with the instructor in a difficult investigation where the instructor does the thinking and the student most of the work.

There is a good field in connection with analytical methods; perhaps none better

for a start than an investigation of the student's ability to duplicate work requiring complex manipulation.

Considering the length of time available for work in the undergraduate courses of most technical institutions, but little research work can be done by the undergraduate unless at a sacrifice of time needed for systematic analytical training. Thesis work has many sins of omission to answer for and some of the other kind.

Statement of results.—Last, but by no means least, is the ability and necessity to put the results of work in clear and intelligible form. This must include both a statement of the facts and the relations and meaning of the results of the work, whether these relations be scientific or commercial. The ability to do this distinguishes the chemist from the analytical machine.

Discussion of the question, "What should be an implement test?" was opened with a paper by E. Davenport, of Illinois. He stated the three considerations affecting the value of an implement to be (1) efficiency, (2) draft, and (3) durability. That machine should be considered the best which does the best work under average conditions. In determining the efficiency the quality as well as the quantity of the work should be taken into account, and the durability of the whole machine is to be measured by that of its weakest part. The dynamometer test is the one most frequently applied, but "it can teach us nothing more than the expense of operating, or give indication whether the demand for power will be steady or unsteady, whether it will be easy or hard upon the team. Of all the tests it is the easiest applied, and while valuable it seems that every other consideration is even more valuable." A sharp distinction is drawn between a machine test proper and a field trial. The latter is more valuable because it tests the machine in a great variety of conditions and takes into consideration its natural life. The speaker strongly recommended "the examination of old machines that have been under fair management to discover the parts that are first suffering. This, with a field trial for quality of work and ease of draft, is about all that can be done, and will in most cases constitute a fairly satisfactory test, though greatly inferior to what the companies themselves are doing, for commercial reasons."

The discussion was continued by R. J. Redding, of Georgia, who stated that "(1) it should be an inflexible rule that no machinery or implement or appliance be tested primarily in the interest or for the benefit of competitive manufacturers or dealers; (2) in general, the expediency of a suggested test, with reference to its bearing upon agriculture, should be affirmatively determined upon by the director or other officer in charge of the station, and (3) with few exceptions machinery to be tested should be such as the station is prepared to use regularly, or at least occasionally, in conducting the experiments and investigations in the usual course."

The form in which the results of these and similar tests should be published was discussed by C. S. Plumb, H. J. Wheeler, H. J. Patterson, E. B. Voorhees, R. J. Redding, and James Wilson. The consensus of opinion seemed to be that the essential results of these tests should be given to the public, whether they were of such a nature that they could be used for advertising purposes or not, although great caution should be exercised in the matter.

A paper on "Influence of width of tire on draft of wagons," was read by H. J. Waters, of Missouri.

H. J. Wheeler, of Rhode Island, read a paper on, "The recognition of the acidity of upland soils as an indication of their need of calcium carbonate."[1]

D. E. Salmon, of the Department of Agriculture, discussed the "Effect of the tuberculin test upon the dairy." He stated that tuberculin has been found to be a successful diagnostic in the hands of experienced persons when it has not been used at too frequent intervals on the same animal. He discouraged its promiscuous use by buyers of stock. He maintained that it was useless to kill diseased animals and not to disinfect the stables. The work of inspection and disinfection should be done by experienced officials of the State. Methods of disinfection were briefly

[1] The essential features of this article have appeared in Rhode Island Sta. Rpt. 1895, p. 232 (E. S. R., 8, p. 571).

described. The free use of hot water or steam for this purpose was recommended, although bichlorid of mercury (1 to 1,000), carbolic acid, and sulphuric acid are effective, but must be used with caution.

The following paper was presented by E. B. Voorhees, of New Jersey:

Should Milk be Sold on the Basis of Quality?[1]

The very great progress in the dairy industry in this country in recent years has been due in large measure to the investigations conducted by the various experiment stations. These investigations have, however, been largely along lines connected with the production of milk and the manufacture of butter and cheese. Aside from the work of the bacteriologist, but little attention has been given to that enormous and constantly increasing branch of the industry, the retail milk trade, particularly the study of methods by which differences which occur in the cost of nutrients, due to inequalities in composition, may be so adjusted as to encourage the producer of milk of good quality and to protect the consumer against what may be termed "indirect adulteration." An investigation along this line, for the purpose of learning something of the variations that occur in the composition of milk as delivered to consumers, was begun in New Jersey the past year, the results of which indicated very strongly that variations in the cost of nutrients are much greater than legitimate business interests can maintain.

The samples represented as nearly as possible the actual supply of the four cities from which they were secured, viz, New Brunswick, Newark, Trenton, and Camden; that is, while samples were not taken from every dealer, the number taken represent a fair proportion of both small and large producers and dealers. The samples were in all cases taken in the morning from the delivery wagons on their route and from the stores of retailers, and, therefore, represent milk as delivered to consumers. They were taken in some cases from full cans, in other cases from cans partially full, in others from cans almost empty, and still others from bottles. In the latter case the entire contents of the bottle represented the sample.

The analyses of the samples were made immediately upon their receipt in the laboratory by the chemical methods adopted by the Association of Official Agricultural Chemists.

The cost as delivered to consumers was practically the same everywhere, namely, 8 cents per quart.

In the samples obtained from New Brunswick the variation in total solids ranges from 11.82 per cent to 14.03 per cent, or a difference between highest and lowest of 2.21 pounds per hundred, or 18 per cent dry matter. The variation in fat ranges from 2.99 per cent to 4.57 per cent, a difference of 1.58 pounds per hundred, or 50 per cent. The average composition of the milk, however, is higher than the average composition given as representing normal milk, and in but one case is the variation in the proportion of the different constituents so marked as to indicate that the samples were not fairly representative of whole milk.

In the samples from Newark the total solids range from 10.81 per cent to 14.86 per cent, a difference of 4.05 pounds per hundred, or 37 per cent, while the fat ranges from 2.56 per cent to 6.92 per cent, a difference of 4.36 pounds per hundred, or 130 per cent. The average composition is, so far as total solids are concerned, practically identical with the New Brunswick average, though showing a slightly higher percentage of fat. In one sample the content of total solids and fat is so low as to create a suspicion of adulteration, and another contains an undue proportion of fat.

In the samples from Trenton the percentage of total solids ranges from 10.61 per cent to 13.96 per cent, a difference of 3.32 pounds per hundred, or 31 per cent. The fat ranges from 2.97 per cent to 4.80 per cent, a difference of 1.83 pounds per hundred, or 61 per cent and in one sample only does there appear to be an abnormally low content of total solids and fat.

In the samples from Camden the range in total solids is from 12.06 per cent to 16.55 per cent, or a difference of 4.49 pounds per hundred, or 37 per cent. The range in fat is from 3.28 per cent to 7.76 per cent, a difference of 4.48 pounds per hundred, or 138 per cent. The average composition of the milks from Camden is very much higher than that from the other cities, both in total solids and in fat. Two samples only show an abnormal percentage of fat.

On the whole, however, the milk supplies of those cities may be regarded as extremely good, showing an average of: Total solids, 12.97; fat, 4.13; casein and albumen, 3.37; sugar, 4.75; and ash, 0.72 per cent.

A further study of the results shows that the samples fall into eight distinct classes according to their composition, the first, containing those showing less than 3 per cent of fat; the second, those containing from 3 to 3.50 per cent of fat; the third,

[1] See, also, U. S. Dept. Agr., Office of Experiment Stations Bul. 35.

those from 3.50 to 4 per cent; the fourth, those from 4 to 4.50 per cent; the fifth, those from 4.50 to 5 per cent; the sixth, those from 5 to 5.50 per cent; the seventh, those from 5.50 to 6 per cent; and the eighth those containing over 6 per cent of fat.

In the first class but four samples are recorded in which the total solids average less than 12 per cent and the fat 2.84 per cent, an average composition so low as to lead to the belief that the samples included do not represent the whole milk of well-fed, healthy animals, but since these milks were sold at the same price per quart as others of higher quality, they are not excluded from this discussion.

In the second class 16 samples are included, showing an average of 12.15 per cent total solids, and 3.34 per cent of fat.

The third class includes 34 samples, one-third of the whole number, the average composition of which exceeds the average assumed for good milk. The remaining samples, 48 in number, or nearly half, exceed 13 per cent of total solids and 4 per cent of fat.

The fact that milk falls into the various classes already indicated in respect to composition shows at once that at a uniform price per quart there is a wide variation in the cost of nutrients to the consumer. Assuming, for the present, that the quality of the nutrients, as represented by the total solids, is quite as good in one class of samples as in another, the cost per pound of total solids in class one, at the rate of 8 cents per quart, or 2 cents per pound,[1] is 35 cents, while in the eighth class it is 26 cents, or 38.5 per cent greater in class one than in class eight. In other words, $100 spent for milk of the quality represented by the eighth class would purchase nutriment that would cost $138.50 if purchased in the form of milk of the quality represented by class one.

These extremes exhibit the range of cost; the average cost would be 31 cents, which is fairly representative of class four, which includes about one-fourth of the total number of samples; more than one-half of the total number, however, show a lower quality than the average.

The fact that the constituent fat in milk varies more than the remainder of the constituents, or solids-not-fat, shows that the more expensive nutrients contained in the poorer milks are also less valuable as food than the less expensive nutrients contained in richer milks.

The fat contains about two and one-fourth times as many heat units or calories per pound as protein or carbohydrates; hence, so far as supplying the needs of the body for heat is concerned, a pound of fat is two and one-fourth times as valuable as a pound of protein or carbohydrates.

A study of the average composition of the milks in the preceding classification shows that as the total solids in the milk increases for the various classes the percentage of fat is increased in greater proportion than the solids-not-fat. For instance, in class one but 25.9 per cent of the total solids is fat; in class two, with slightly over 12 per cent total solids, it is increased to 27.5 per cent; in class three, with over 12.50 per cent total solids, the fat constitutes 30.2 per cent of the total nutrients; in class four, with over 13 per cent total solids, the fat is increased to 32.2 per cent; with 13.70 per cent total solids in class five, the fat is 34.2 per cent; in class six it is 37.20 per cent; in class seven it is 38.2 per cent, and in class eight the fat constitutes 45.8 per cent of the total solids contained in the milk.

In other words, the total solids as represented by class six, for instance, contains 20 pounds per hundred more of fat than is contained in 100 pounds of total solids represented by class one. The consumer not only secures his total solids in the richer milk at a lower cost per pound, but also obtains a product which is very much richer in nutritive matter.

The facts brought out by this investigation in regard to the variation in the cost and quality of the nutrients contained in milk show very clearly that the standard now in use as the basis of sale, viz, the quart, is illogical, and is unfair both to the consumer and to the producer of good milk.

That is, the method results in indirect adulteration and affects both the consumer and the producer of good milk. Because of the wide variations that occur the consumer is really affected more than by the actual adulteration that is practiced, if we assume that the four samples of very low quality, which constituted but 4 per cent of the whole number examined, were adulterated. The chief fear on the part of the consumer seems, however, to be on that score, as is evidenced by the fact that in many States large annual appropriations are made the express purpose of which is to exercise a control or to pay the expenses of a milk inspection which has for its sole object the detection of adulteration. In our State it costs over $12,000 annually for this purpose.

Assuming that the percentage of fat is a safe guide as to the nutritive value of milk—which assumption is practically borne out by this study—the content of this constituent would better serve as a standard than the quart. For instance, on the

[1] On the average, a quart of milk will weigh 2.15 pounds.

average the milks examined, and for which at the average price of 8 cents per quart $4 per hundred were paid, contained in round numbers 4 per cent, or 4 pounds per hundred of fat. If milk containing 4 per cent of fat is worth 8 cents per quart, milk containing 3.50 per cent would, on the same basis, be worth 7 cents per quart, and 3 per cent milk only 6 cents per quart, while milk containing 4.50 per cent fat would be worth 9 cents per quart, and 5 per cent milk, 10 cents per quart. If the fat content standard were adopted, the consumer would be protected in the sense that he would receive just what he paid for, and the producer of a high quality product the advantage of a higher price, which fairly belongs to him, because of the greater cost of producing milk of a better quality.

This method of purchasing milk is now used in many creameries with entire satisfaction to both the seller and the buyer, and the facts brought out in this investigation indicate that its adoption is quite as important in the purchase of supplies for the home where the entire product is used as food.

Investigations now in progress at our station indicate, too, that this method is entirely practicable; it only requires that the producer shall understand the chief causes of the variations in the quality of milk, as far as now known, and that he adapt himself to those conditions, and make frequent tests of the fat content of his product, which may now be readily accomplished by the use of inexpensive apparatus, and which can be operated by any intelligent person. It would seem that this subject is well worthy the attention of our experiment stations, to determine whether the sums now expended for milk inspection, as now conducted, may not be directed toward an inspection which will afford a better protection of both producer and consumer, and that a careful study should be made of the further and allied question as to the methods by which sales on the basis of quality may be accomplished in the retail trade.

C. C. Georgeson, of Kansas, read the following paper:

How Shall Selling Milk on the Basis of Quality be Accomplished in the Retail Trade.

The subject is not of my own choosing, but I have consented to say something in the hope that it will set the ball rolling and perhaps others can bring out points of value. I recognize the fact that it is a question of vast importance to consumers of milk, especially in our cities. The means for determining the quality of milk which have been invented as yet, are not of a nature that the ordinary consumer, the householder, can make use of. He is at the mercy of the dealer, and it would be highly desirable if some plan could be evolved by which he could always be assured that the milk he bought was of a desirable quality. To protect the consumer against impositions, several States have laws which fix the quality of the milk that is allowed to be sold within their borders, and all large cities, and every considerable town and village, have regulations which require dealers to furnish milk of a certain quality to their denizens.

But before we discuss plans it is essential that we should have a clear understanding of what is meant by the word "quality." Does it simply mean that the milk must contain a certain per cent of fat and solids not fat? It is possible for milk to be of a good standard in this respect and yet be a very objectionable article of food. It must also mean that it shall be pure milk, neither diluted with water nor adulterated by the additions of preservatives or other substances intended to deceive the consumer. It means that it must be clean, free from dust and dirt, and it means that it must be palatable, free from any taint offensive to taste or smell. It means it must be healthful, free from disease germs of every description, and that it must be the product of healthy cows. In short, if a proper standard of quality is established, it must cover not the composition merely, but all of these other points by which milk can be deteriorated. It means pure, sweet, normal, wholesome milk.

Now the question is, What means can be devised to provide such milk, and such milk only, for the retail trade? Only experts can determine whether a given sample of milk is of the quality here designated. The chemist and the bacteriologist must both be consulted. This at once excludes all possibility that the average consumer can determine the quality. If it were simply a question of the per cent of fat and solids-not-fat in the milk, the difficulty might perhaps be met without great trouble, but the estimate of nutritive matter does not determine the healthfulness of the milk, which is still more important. Even though a test should be devised so simple that by stirring a chemical into a sample of milk, the several constituents of that sample would proceed to arrange themselves in strata, and the per cent of each could be read off on the side of the glass, still the consumer would be unable to determine from this whether it was a fit sample of milk to give his children; it might still swarm with germs of diphtheria, typhoid fever, or tuberculosis, for the detection of which I have so far failed to hear of any short-cut process.

To be assured of an acceptable quality of milk, the average consumer is, therefore, necessarily dependent on the regulations established by law and on the officers

entrusted with the enforcement of the law. Does not the question therefore resolve itself into this, "What is the most effective and least cumbersome system of regulations which can be adopted for the retail milk trade?" On this subject there are necessarily many and various opinions, and it would be a difficult matter to draft a law which would cover all cases equally well. But it is easy enough to point out some of the essential features. The law should not merely deal with the milk as it finds it in the market; it should reach out to the cow in the barn of the producer, to the feed, cleanliness, and the sanitary conditions which surround her; it should also reach out to the health and cleanliness, not only to the man who milks and feeds the cow, but to his family and the persons with whom he is in daily contact; it should reach to the water the cow drinks, and to the water which is used in cleaning the milk vessels, and it should protect the milk from contamination in transit from the time it leaves the cow till it is poured in the pitcher of the consumer. Anything short of this is imperfect and can not insure a healthful quality of milk to the consumer. Do you say that this is too much, that it would be impossible to enforce regulations which would be so far reaching. I say it is already done in several places with entire success, and what is done successfully on a comparatively small scale can certainly be done with equal, or even greater success, on a large scale with properly adjusted machinery. To be sure this supervision and the care needed on the part of the producer would cost something, and at present it is only the well-to-do who can afford milk of the quality here aimed at; but why should not a city guarantee such milk to all its denizens, both rich and poor. It is to the interest of every city to preserve the public health and it is because of a lack of supervision that serious diseases are sometimes spread broadcast among dense populations by the most perfect of all means of dissemination, the milk used in the family.

I know of no more perfect system for the supply of absolutely pure, sweet, healthful milk to city consumers than that adopted by a private company in the city of Copenhagen. It was primarily a philanthropic measure designed to bring milk of the quality here designated within the reach of the poor as well as of the rich; and they do it there with only a small charge per quart more than that of ordinary milk. This company buys the milk from a large number of producers, and it is shipped in to a central distributing point by rail and wagon. The producers of milk for this company must subscribe to a very strict code of regulations, which prescribes the kind and quality of feed the cows must have and proscribes a list of feeds they must not have. It describes how and when the cow must be milked and the measures that must be taken to insure cleanliness, both as regards the cleanliness of the animal, the milker, the stable, and the air in the stable. They must agree to handle the milk in a certain way and to deliver it promptly at the transportation depots. The cans are sealed when they leave the farm. The dairy farmer must submit to the inspection of his herd at any and all times by veterinarians in the service of the company, and, besides these, traveling inspectors are constantly on the road and drop in unexpectedly to ascertain if the feeding, milking, and cleanliness agreed upon is lived up to. Great care is taken to prevent the spread of disease. If a laborer on the farm, or any member of his family, is taken down with a contagious disease, the producer must notify the company and stop the milk until the case is investigated. These and many other points are strictly enforced. When the milk arrives at the station and as each can is opened, an expert is at hand who tastes and smells of the milk, and if a can is tainted in the least it is set aside and the cause investigated. Samples for analysis are likewise taken daily. After the milk is filtered in specially constructed filters it is again put in sealed cans and loaded on delivery wagons, which distribute it through the city. The milk is not accessible to the driver except through the faucet at the bottom of the can, and it is delivered directly to the house of the consumer. They furnish a special quality, which they call "children's milk," to supply which only the milk of particular cows, set aside by the company's veterinarians, is used. The company finds it possible to sell such milk at 5.5 cents a quart for children's milk and 4.5 cents for ordinary sweet milk, while milk from other sources without guaranty is sold at 4 cents.

Milk producers may be divided into three classes: (1) Those who furnish a specially high-class article to private customers at an advanced price; (2) those who furnish milk to city dealers who retail to the public; and, (3) a miscellaneous class of producers, who peddle their own milk through the streets. In the first case the character of the trade requires the milk to be of high-class quality, or the producer will lose his customers, and yet without supervision it is possible to introduce disease even here. In the second case, the milk dealer can, if he will, exercise some degree of supervision over the source of his supply; but it is to him simply a question of profit, and where the law does not require supervision he is apt to buy the milk wherever he can get it the cheapest if it only is sufficiently good not to contaminate all his milk with a taint of offensive taste or smell. The supervision as to the per cent of solids and fats which the city might require is no guaranty that it is a wholesome article of diet. And there is still less protection to the consumer

against deleterious milk peddled by the third class of producers from the miscellaneous character of the supply.

These being the conditions, how is it possible to guarantee the quality of the milk in the retail trade? I confess that I see no other course but for each State to enact stringent laws, which shall prescribe detailed regulations of such a nature that if they are lived up to they will insure that none but good milk is ever offered for sale within its borders, and enforce them, appoint a dairy and food commissioner with a competent and numerous corps of assistants, whose business it shall be to visit every farm from which milk is sold, keep a constant supervision over the health of the cattle, the manner of their feeding and treatment, and the handling of the milk until it reaches the consumer, and with adequate penalties for infractions of the law.

The next paper was read by J. L. Hills, of Vermont.

What is the Most Profitable Way to Dispose of Skim Milk?

This paper is made up of ideas regarding relative profits accruing from the use of skim milk in various ways, based largely upon facts brought out by American experiment-station investigation work.

Skim milk is used (1) as a food, human and animal, (2) as a fertilizer, and (3) in the arts.

Waiving, for the time being, the first and most important use in order to get the minor ones out of the way, skim milk, and indeed dairy by-products in general, are occasionally used directly as fertilizers. Such use is obviously wasteful, and should only be made a last resort, in the absence of animals to which it may be advantageously fed. Its analysis indicates that at current Eastern prices for similar ingredients in commercial fertilizers it is worth about 10 cents per hundred as plant food, a price at which too many dairymen are willing to sell. It is needless to remark that the nitrogen, phosphoric acid, and potash are in readily available forms.

The use of skim milk in the arts is, I believe, comparatively limited as yet. The precipitated casein has entered into the composition of certain forms of cement or glue and of artificial ivory.

Turning now to what must and will ever constitute the main use of dairy by-products, the feeding of animal creation, we find skim milk to be well adapted to and relished by every domestic animal, as well as by mankind.

The subject under discussion here naturally divides into the feeding of (1) animals and (2) of men.

Animal feeding.—There are five reasons which thus far have served to reduce the use of skim milk by city people and, indeed, in part by the dairymen themselves:

(1) Skim milk is a farm product, and especially in dairy districts is made in excess of the human requirements of the immediate vicinity.

(2) It is bulky, dilute, and transportation rates per unit of food are relatively high.

(3) There is a strong prejudice against its use among those who do not appreciate its true dietetic value and its relative economy which is difficult to overcome.

(4) It has as yet not been so manipulated as to be put up in attractive and appetizing form.

(5) Its sale for human consumption is prohibited in many States.

For these reasons, therefore, almost all skim milk is fed upon the farm. It is usually fed to pigs or calves, but sometimes to cows, horses, colts, sheep, lambs, and poultry, and even to squashes and pumpkins designed to beat the record for mammoth growth at the next county fair.

Many American stations—notably Iowa, Maine, Massachusetts, Michigan, New York, Pennsylvania, Vermont, and Wisconsin—have made feeding experiments on various classes of farm animals, with the view of comparing the relative values of skim milk and other foods from the economic standpoint. These have usually resulted to the advantage of the dairy by-product. So far as the writer is aware, no experiments have as yet been reported by any American station showing that skim milk is more profitable when fed to one than to another class of domestic animals. From the nature of the case, this must always be indeterminate and variable, because changes in the market prices of pork, veal, beef, milk, etc., and in the most profitable means for the disposal of skim milk when animal feeding alone can be depended upon, must ever be a local problem to be solved by the individual. It may not be amiss to say, however, that the results of experiments, as well as the general experience of well-informed and practical dairymen, seem to indicate that under the dairying conditions and market prices of farm produce in the Eastern States skim milk is more profitable when fed to swine than when fed to cows, calves, or sheep, provided the animal is forced to rapid growth and sold at not to exceed 250 pounds live weight. Several investigators have tried to improve skim milk for animal feeding, with the view of making it more palatable or nutritious. Morfit proposes to add to and blend into skim milk white sugar and cotton seed oil, the whole being boiled in a vacuum pan to one-third bulk; Dierking emulsifies with it a mixture of rape-seed oil and

some mucilaginous material, making a sort of artificial cream, while Rhenstrom manufactures feeding cakes of varying composition, made by precipitating, drying, and grinding the casein of the skim milk, mixing the same with more or less nitrogenous or carbohydrate feeding stuffs, according to the nature of the cake desired, and finally strongly compressing the mass.

While primarily intended for animal consumption, there is no reason why such substances, if palatable and agreeable, should not enter into human dietaries, a consideration which brings us naturally to the subject of skim milk in human feeding.

Human feeding.—It will be remembered that the fundamental principles of feeding, human and animal (abridged from Dr. Atwater's statements), are:

(1) Food builds up body tissues, keeps them in repair, or is consumed to yield energy in the form of heat to keep the body warm and create strength for its work.

(2) The most healthful food is that best fitted to the wants of the user. It must supply the different nutrients in digestible and palatable (agreeable) forms, in the kinds and amounts needed by the body to build up its several parts, to repair them, and to yield energy in the form of heat and muscular power.

(3) The cheapest food is that which furnishes the most nutriment at the least cost.

(4) The most economic food is that which is both most healthful and cheapest.

It should also be borne in mind that the four cardinal sins of American food economy are (1) extravagance in the purchase of food; (2) ill-balanced nutrients, digestible carbohydrates being in excess and digestible protein relatively lacking; (3) overeating, and (4) poor cooking.

Does skim milk fulfill the conditions of the fundamentals already given? Does it tend to save us from our dietary sins? It may be safely said, barring exceptional cases and presupposing healthy animals, that it is well balanced, healthful, digestible, agreeable, cheap, economical; and that in the highest, truest sense of the words, in the light of the general food of the human race, the most profitable means of disposing of skim milk is as human food. Further than this, it is safe to say that once the obstacles now in the way of the more general use of skim milk in the cities are removed larger sums than are now received by way of the pork barrel will be returned to farmers for skim milk used.

Skim milk is particularly valuable in human dietaries for two reasons: (1) Its dry matter consists largely of digestible protein; (2) it forms one of the cheapest forms of digestible protein.

In other words, it serves to narrow and to cheapen our naturally too wide and too costly rations.

By reference to Dr. Atwater's tables, published in the Yearbook of the Department of Agriculture, and in his several valuable monographs, we find that a pound of separator skim milk contains 0.034 pound protein and 170 calories.

"A pound of lean beef contains about 0.180 pound of flesh formers and has a fuel value of 870 calories. Two quarts and a half, or 5 pounds, of skim milk will furnish the same amount of flesh formers, and have nearly the same fuel value as a pound of round steak. Two quarts of skim milk have a greater nutritive value than a quart of oysters; the skim milk has 0.14 pound of flesh formers and fuel value of 680 calories, while the oysters contain only 0.12 pound of flesh formers and have a value of 470 calories. The nutriment in the form of oysters would cost from 30 to 40 cents, while 2 quarts of skim milk would have a market value of not more than 2 or 3 cents. An oyster stew made of one part oysters and two parts skim milk would owe its value for nutriment more to the milk than to the oysters. Bread made with skim milk would have much more of the flesh formers than when made with water."

The following table, taken from the report of the twenty-sixth annual meeting of the Vermont Dairymen's Association gives—

A comparison of skim milk with other foods.

	One pound contains—		
	Refuse.	Flesh formers.	Fuel Value.
	Pound.	*Pound.*	*Calories.*
Whole milk		0.033	325
Skim milk		.034	170
Oysters, solid (equal to 1.5 pounds skim milk)		.061	235
Bluefish (equal to 1.5 pounds skim milk)	0.486	.098	205
Chicken (equal to 2 pounds skim milk)	.348	.148	325
Beets (equal to 1 pound skim milk)	.200	.013	170
Potatoes (equal to 2 pounds skim milk)	.150	.018	325
Bananas (equal to 1.5 pounds skim milk)	.400	.007	290
Beef:			
Round (equal to 4.5 pounds skim milk)	.077	.181	870
Sirloin (equal to 6 pounds skim milk)	.130	.159	1,040
Shoulder (equal to 4 pounds skim milk)	.164	.161	716
Shoulder, clod (equal to 5 pounds skim milk)		.193	835

From the standpoint of economy, skim milk is a cheaper source of protein at 50 cents a hundred than is any other food. It is cheaper at $1 per hundred than is any food except wheat flour, corn meal, and bran, but one of which is adapted to narrow a ration. Most dairymen consider themselves well paid to receive the equivalent of 25 cents per hundred pounds for skim milk when turned into pork, and many are willing to sell it at the creamery at 15 or even 10 cents per hundred.

It will be recollected that earlier in this paper dilution, prejudice, lack of attractiveness, and legal enactment were stated to be barriers between producer and consumer. Are they insurmountable?

(1) Dilution may be avoided by (*a*) casein precipitation, filtration, the dried curd being marketed, (*b*) by concentration and sterilization (or pasteurization). It is safe to say that details for the successful management of this portion of the work would follow popular demand for the article.

(2) Prejudice can be best overcome by education, which may extend to legislative halls as well as to the haunts of poverty. I look for great good to come from the dissemination of the results of the food investigations of the Department of Agriculture.

(3) Lack of attractiveness in the method of its presentation to the public may be solved, perhaps, by the making of cottage cheese, condensed skim milk, or in other ways, which will quite surely be worked out by dairymen if they are aroused to the opportunities open to them.

Legal enactments forbidding the sale of skim milk might now be far better replaced by acts permitting the sale of any healthful milk, skimmed or whole, upon its guaranty of solids and fat and by acts looking to the health of the animals and the sanitary condition of the stables.

I have made no reference to the manufacture of filled cheese as a profitable means of utilizing skim milk, since under laws now existing the wrongful profits accruing therefrom have been shut off.

The discussion of the question, "Can station farms be conducted so as to not unfit them for experimental purposes?" was opened by R. H. Miller, of Maryland, in a brief paper, and was participated in by R. J. Redding and H. J. Wheeler.

The question, "How nearly can physical conditions of soil be controlled and methods for the same?" was discussed by M. Whitney, of the United States Department of Agriculture, who described electrical apparatus of his own invention for determining, by means of electrical resistance of the soil, the amount of moisture in the soil, the temperature at different depths, and the quantity of soluble salts it contains. The apparatus is also adapted to the determination of the progress of leaching in the soil and of the depth to which rainfall penetrates. He stated that several of these instruments are in successful use by farmers.[1]

I. P. Roberts, of New York, described a new dynamometer for use in determining the draft of agricultural machinery.

W. H. Jordan, of New York, briefly discussed, "Reforms which should be inaugurated in the methods of making feeding experiments." He classed feeding experiments under two heads—those which are undertaken for the purpose of discovering the fundamental principles of animal nutrition, and those which may more properly be styled tests of theory or experiments as object lessons. The first class is of the greater importance, but a large proportion of the experiments which the stations have heretofore made belongs to the second class. In the speaker's opinion, reform in feeding experiments should come along the line of a closer study of the materials fed and the product obtained and the lengthening of the feeding periods until we are sure that we have established and maintained certain effects from certain rations. The discussion of this subject was participated in by I. P. Roberts, W. A. Henry, J. B. Lindsey, James Wilson, and C. C. Georgeson. The principal point brought out was that while the value of scientific experiments is unquestioned, many practical experiments which do not lend themselves to scientific accuracy may be conducted with advantage by the stations.

Two papers—(1) "A brief statement concerning our present knowledge of the com-

[1] See U. S. Dept. Agr., Division of Soils Bul. 6.

position of crude fiber and extract matter," and (2) "The distribution of galactan in agricultural plants and seeds"—were presented by J. B. Lindsey,[1] of Massachusetts.

Other papers presented were "Irrigation for the Eastern agriculturist," by F. W. Rane, of New Hampshire; "Improvements in laboratory methods of teaching agriculture," by T. F. Hunt, of Ohio, and "Improvements in and further tests of the laboratory methods for teaching agriculture," by C. S. Plumb, of Indiana.

[1] See Massachusetts Hatch Sta. Rpt. 1896, p. 92.

SECTION ON HORTICULTURE AND BOTANY.

Three sessions of this section were held in the lecture room of the Cosmos Club, F. W. Card, of Nebraska, presiding.

G. E. Stone, of Massachusetts, read the following paper:

Vegetable Physiology in Agricultural Colleges.

The subject of teaching plant physiology in agricultural colleges, as well as other scientific colleges, is one of great importance. It is no exaggeration to state that there has been no branch of botany so neglected in our country as the physiology of plants. It is in fact the last branch of botany to be taken up, and it is only within the last few years that any serious attention has been given to it whatever. This fact, too, is rather singular when we take into consideration that agricultural practices are based upon the laws of vegetable physiology. Many years ago Dr. Lindley, when editor of the Gardeners' Chronicle, emphasized this very point in the statement that "good agriculture and horticulture are founded upon the laws of vegetable physiology," and no less an authority than Marshall Ward has recently expressed himself in a similar manner. At the same time we have been content to teach agriculture and agricultural botany in our colleges for years without considering it necessary to give the student anything more than an elementary course in morphology, followed by flower analysis and the gathering of a herbarium, with a little histology thrown in. The history of botany in our colleges shows that it has followed this sequence in its development. At first many of our institutions gave attention only to morphology and systematic botany. This knowledge enabled the student to know a rhizome from a root, the different parts of a flower, and how to determine the name of a plant as well as the family to which it belongs. Then came a course in histology and cryptogamic botany, which has been followed in later years by one in vegetable pathology. To be sure, certain physiological facts have been mentioned in our courses of botany and agriculture, but so far as I am aware the majority of our colleges have touched upon physiology only in an incidental manner. I know of graduates of agricultural colleges who could not define the functions of a leaf or tell anything about the known metabolic processes which take place in it, although they might be able to tell something about its structure, simply because they never had an opportunity in their course of study to learn anything about such facts. Now, I ask, should not such facts be well understood by our students in agricultural colleges? Is not a knowledge of the function of the leaf fully as important as that of its structure?

There are many reasons why more attention has not been paid to vegetable physiology in America, and I shall endeavor to point out some of them. The first botanical activities in a new country are always devoted to systematic work, and this is quite logical. The systematic botany of America has required many botanical workers, and will require the life work of some others before it is completed and before botanists will be compelled to turn their attention to other fields, such as the morphology, physiology, and biology of plants. This fact has already impressed itself upon the mind of our younger generation of botanists, and within the last six years not a few of them have endeavored to take advantage of the superior courses in morphology and physiology offered in Germany by such masters as Strassberger, Pfeffer, and Goebel. Indeed, if we reflect upon the history of botanical science in Europe, we will note that a similar development has taken place there. First came the systematic workers who were represented by Linnæus, Jussieu, and the De Candolles, and they were followed by the morphologists and physiologists, like Hofmeister, Strassberger, Sachs, Naegeli, and De Bary. But the systematic work of Europe having been practically completed years ago, morphological and physiological questions received attention there much earlier than we could expect here, and practically these are the only questions which receive much attention in Europe to-day.

America, however, has not been entirely without physiological workers in the past, and it would be an injustice if I did not call attention to some of them. We

have only to recollect the able experiments of Professor Draper on the chemistry of assimilation, carried on as far back as 1844, and those of William S. Clark, president of the agricultural college at Amherst, who was as much chemist as botanist, on plant growth. Both of these men did excellent work, although it is but justice to state that undoubtedly it is not what it would have been had their environment been different.

Again, the facilities for teaching physiological botany in America have not been what they ought, nor have the opportunities offered by some of our larger universities been taken advantage of. It can not be said, however, that this is due to the lack of interested students, but rather to the lack of interest on the part of the gentlemen who have had such courses in charge. The truth of the matter is that if one wished to take a course in experimental physiology a few years ago he could not do it in this country, because no institutions offered a course in that branch which would be satisfactory, and furthermore because there were no laboratories equipped for that purpose.

Previous to 1890 there were only three or four American botanists who ever took a genuine course in physiology in a foreign university, but since that time there has been something like a dozen who have availed themselves of this opportunity, and as a result vegetable physiology has received an impetus not only in our colleges, where already one or two laboratories, as at Purdue, the University of Minnesota, etc., have been established, but also in our secondary schools and high schools, where the text-books now in use contain some physiology.

Another factor which is responsible for the nondevelopment of vegetable physiology, and we may justly say of botany in general, is the position which some of our principal higher universities have taken in regard to introducing pure botanical courses. The course termed biology, which they offer mainly through zoologists, has made the development of higher botany impossible. Most of the zoologists having these biological courses in charge have apparently looked upon botany as a subject worthy of being taught merely to women and children. In regard to such conceptions of botany I have no objections to urge, for, judging from the way in which this subject has been studied in many of our colleges, I do not see how it could be considered worthy of any more serious consideration. This so-called biology as understood here and in England (though not in Germany), which endeavors to convey to the student at least a fairly good conception of both the physiological and anatomical characteristics of a few plants and animals, is in my estimation far superior to that botany which leaves the student with merely the knowledge of the Latin names of a few hundred plants. As far as my own observation goes, the botanists have been much more backward in this country than the zoologists, and they are consequently responsible for the inferior position which botany has taken in our institutions of learning.

In Germany, however, this is by no means the case. No names can be found among the contemporary zoologists which excel those of Naegeli, Sachs, and De Bary.

Before taking into consideration, however, the details connected with plant physiology in its relationship to agricultural colleges, let us have a clearer understanding of just what it is. The necessity of defining a branch like physiology is in itself a reflection on our botanical development, especially when there are so many excellent text-books treating of physiology in a distinctly characteristic manner. Nevertheless such misconceptions exist, and I feel justified in calling attention to them. There has never been any question as to what physiology implied among the animal physiologists; neither has there been any among European vegetable physiologists. But right here in our American agricultural institutions we have had professors of botany who did not, and do not to-day, seem to know exactly what ground this subject covers. One institution that I have in mind has advertised for years a thorough and complete equipment for work in vegetable physiology, and yet this very same institution has scarcely had a single piece of purely physiological apparatus in its outfit during the whole time. The institution I refer to by no means stands alone in this matter. There are others holding the same conception of physiology. The fact in regard to the matter is this—that there are still some botanists who insist on calling the study of the structure of a stem or leaf, or the mounting of a slide, etc., physiology. The origin of at least part of this erroneous conception is not far to seek, neither is it easy to eradicate, so long as our institutions will employ such abominably antiquated text-books as Wood's Class-book of Botany, a work which pretends to devote a few pages to physiology, though scarcely touching the subject, except in the most primitive manner. Physiology as treated by such eminent animal physiologists as Foster, Bowditch, Ludwig, Du Bois Reymond, and others, implies function, and I can not understand how a botanist can even have looked into the text-books of Vines, Sachs, Pfeffer, Frank, and others without obtaining a similar conception. In the treatment of this subject we shall therefore follow the European conception rather than the provincial American, and we shall now pass on to a consideration of the advantages to be derived from a study of physiology.

Why should physiology be taught in agricultural colleges? Because it is that branch of botany which has the closest relationship with all horticultural and agricultural knowledge and practice. It is, in fact, the very foundation of these branches. It concerns itself with the functions of plants rather than with their structure—factors in plant life which present the most puzzling phenomena. It concerns itself with all the questions connected with plant food, whether taken from the soil or air, with symbiosis, co-relation, vegetable pathology, and all of those intricate processes which manifest themselves through the action of such external stimuli as heat, light, moisture, etc.

It requires no extensive reasoning to show that of all the factors which practical gardeners, floriculturists, horticulturists, and agriculturists have to contend with, that of the relation of the plant to external stimuli is by far the most important.

Physiology should, therefore, occupy a prominent place in the curriculum of every agricultural college. I do not wish, however, to imply that we should dispense with any of our other branches of botany, for a good grounding in the elementary branches, such as systematic botany, morphology, and histology, is absolutely essential. For example, physiology should never be taken up as a study by itself until the student has had a laboratory course in histology. Such a course would be illogical and absurd. It would be just as ridiculous for the student to do this as it would be for an untrained engineer to attempt to run a machine of which he knew absolutely nothing. A training in physiology has, furthermore, a great bearing on station work, especially in the investigation of plant disease, fertilizer experiment, spraying of plants, and in fact in every kind of agricultural and horticultural work. As our experiment station workers are largely trained in our agricultural colleges, they should therefore have the advantages of a physiological training. A large number of our plant diseases have their origin in physiological disorders, and here, too, we have neglected physiology as a preliminary training to the study of the abnormal condition of plants. The subordination of physiology in this respect finds its parallel only in the neglect of the study of the mechanical condition of the soil. I deem it no exaggeration when I state that a man is not capable of doing his best work in vegetable pathology until he pays some attention to the normal functions of plants. This matter is now, I believe, becoming well understood. If there is any one class of experiments, however, which shows a defect in physiological knowledge more than any other, it is that large class pertaining to various kinds of treatment with fertilizers and fungicides, or in other words, where deductions are drawn from the behavior of plants under different kinds of treatment. In such experiments we frequently find that the number of plants employed is too small from which to draw conclusions, that the conditions are not always similar, and that such factors as individual variation are entirely ignored. It is only after years of physiological experimentation that the effect of the manifold external factors on the vegetable organism can be thoroughly appreciated, and this is especially true in regard to individual variation, which always manifests itself, even when the external factors are eliminated as far as possible. Only those botanists who have worked for days or months at a time, measuring the minute changes which take place in a large series of plants, are in a position to understand the significance of these factors.

It remains for us to call attention to the place of physiology in the curriculum. Inasmuch as physiological botany concerns itself with function, it is essential that any extensive course in this branch must be preceded by a fairly good course in anatomy and histology, just exactly as morphology should precede systematic botany, or normal histology that of vegetable pathology. I believe, however, that in every elementary branch of botany the function of the plant should be taken into consideration. Many of the sound ideas contained in the report of the committee of ten on the teaching of botany in our secondary schools might be profitably employed by our colleges. They recommend always bearing in mind the following questions: What, Why, and How? Indeed, these questions concern themselves with every branch of botany from the mere name of the plant to its biological features. As in the study of morphology and physiology we can pay some attention to the biological features of the plant, so when we take up histology we can sprinkle into advantage some elementary physiology.

The time given to physiology at Amherst is eight hours a week for one term. The term[1] is the last one in the senior year, in an elective course, and is preceded by four terms of elementary botany, which includes morphology, systematic botany, economic botany, histology, and cryptogamic botany, in the order named. The cryptogamic botany requires two terms of eight hours per week each, and special attention is given to pathogenic fungi. The histological botany requires one and one-half terms, while two and one-half terms are given up to the study of morphology, systematic and economic botany. This gives the student a fair basis for physiological study, although it leaves him slightly weak in histology, there being at present only

[1] The year is divided into three terms.

about seventy-two hours of laboratory work devoted to this subject. We would prefer to put the student through some such practical work as Strassberger's text-book, but the time at our disposal is not quite sufficient. It is in the line of histology that we should expect our students to be weak compared with those of other scientific colleges, because in our agricultural colleges there is no practical need of histology being taken up so extensively, since it has less about it of a practical nature and consequently it has to make room for other branches of more importance. The two branches of botany that our agricultural colleges can develop to a considerable extent are vegetable physiology and pathology, and the advanced systematic, histological, and embryological work can be left to other scientific institutions. By doing this we specialize along a line in which we are expected to excel, and are not compelled to work along lines which other institutions have a chance to develop better.

Bearing in mind what has been said in regard to teaching elementary physiology in connection with other branches of botany, I believe that in addition to this one term of eight hours per week will be found sufficient to cover the ground fairly well in the college course. This should also include about twenty lectures on the subject. We consider the matter of lectures an important one, because the subject can be treated better than by the use of text-books.

Many writers treat physiology from the standpoint of irritability. This is an excellent method, because year by year we are tracing phenomena back to some form of irritability, and consequently this subject should be fairly well understood. The physiology of Vines treats the subject in this manner; so does also his later text-book (vol. 2, 1896). The former work, however, is too comprehensive for a college student, although the latter is not. The smaller volume has also the advantage of being up to date, and on the whole it constitutes the best text-book in English that could be substituted for a course of lectures. There is one other book possessing great merit, and that is Sorauer's text-book, entitled Popular Treatise on the Physiology of Plants. Professor Sorauer is well known as an authority on the diseases of plants, and his position for many years as professor in the Horticultural Institute at Proskau has given him an opportunity to write a text-book on physiology particularly adapted to agricultural and horticultural students. While the method of treatment is perhaps not quite so comprehensive as some, the exceedingly practical way in which the subject is handled makes it an excellent supplementary work for the student to read. In regard to laboratory manuals, the best work for the student is undoubtedly Darwin and Acton's Physiology of Plants. On account of the lack of explanatory details connected with the experiments, this work should be used only in connection with a teacher. We have used it for two years and have been able to utilize a large number of the experiments described therein. It is not necessary that each student should perform the same experiment, and the ground can be covered more extensively by dividing the work up into sections, and touching upon the various experiments from time to time in the lectures. Rigid adherence to any text-book is hardly essential or desirable, and in Darwin and Acton's the experiments can be improved upon and frequently simplified. In fact, for an agricultural course there are other experiments which are much better than those described, and should be supplemented.

Much more attention can be given to plant foods. For example, many pot experiments can be made with various kinds of commercial fertilizers and house-plant foods; on the effects of the various potash compounds on the growth of clover, or nitrate of soda on grass; and on the effects of preceding cultures of mustard, buckwheat, lupine, clover, etc., on the growth of forage plants. In short, in an agricultural course the same principle should be borne in mind in physiological experiments as in other branches of botany—namely, to substitute an experiment which possesses some agricultural feature for one which has little agricultural significance, provided this feature does not interfere with the logical and general treatment of the subject. For a practical course in physiology considerable apparatus is needed. This is generally expensive and, when imported, not always satisfactory from the American idea of machinery. Much of the apparatus can be constructed in the laboratory, providing a good set of tools is at hand. Some students possess the natural Yankee technique, and such students are likely to take a genuine interest in physiology on this account. Much time is saved by having the apparatus all ready to put together at short notice, and for this purpose it is necessary to have a good stock of glassware on hand, which should be fitted up for the various experiments.

The discussion following the reading of this paper brought out the fact that while less physiological botany is taught than was considered desirable, yet the importance of the study is fully appreciated.

A paper on the "Place of botany in the curriculum, and time, phase, or phases of work in each period and relation to other subjects in the course," by L. H. Pammel, of Iowa, was read by the temporary secretary, F. S. Earle. The author outlined the

botanical course of the Iowa Agricultural College. No botany is required for admission, but it is provided for in required and elective courses, covering a considerable period of the college course. The use of text-books for teaching elementary botany was advised. Laboratory work should be kept under the guidance of assistants or those in charge, and the economic features should be kept in the foreground, while not neglecting the training value of the subject.

"Industrial teaching of horticulture in agricultural colleges" was outlined by S. C. Mason, of Kansas. The author thought that industrial horticulture offers great advantages in that it gives manual training and presents unusual opportunities for teaching by advanced students. Such a course should be preceded by some botanical work. The horticultural course in the Kansas Agricultural College was outlined.

The following paper by E. S. Goff, of Wisconsin, was read by the temporary secretary:

Laboratory Work in Horticulture.

In the University of Wisconsin all of the students in horticulture have either had two or three terms of work in structural and physiological botany, or else have had one term of work in "plant culture," which gives them the elements of these sciences. The laboratory work which I have been accustomed to give our students in horticulture, with two lessons which I shall introduce this season for the first time, is substantially as follows: I include in the catalogue work in the greenhouse as well as in the horticultural laboratory proper.

(1) One lesson in making cuttings from dormant wood. The students are given wood of the grape, currant, and sometimes of other plants, as Marianna plum. They are taught how to make the cuttings, and are expected to explain the reasons for making them in the particular ways. They perform this work in the laboratory with the approved tools which we furnish.

(2) Two lessons in making grafting wax and grafting paper. The first lesson is in making grafting wax. The materials and utensils are provided, and the students make the wax according to a printed formula. The second lesson is making grafting paper, which is performed under the supervision of the instructor.

(3) One lesson in cleft grafting. This work is done either out of doors in the orchard, or, if in the winter time, in our garden greenhouse. In the latter case trees sufficiently large for cleft grafting are brought in and temporarily planted.

(4) Two or three lessons in whip grafting. This operation is performed with apple scions upon apple seedlings, after the manner practiced by nurserymen. The students have the benefit of three large wall pictures, showing the position of the hands and tools in the different steps of the process.

(5) One lesson in budding. In winter this is performed in the garden greenhouse with materials prepared during the preceding summer and autumn.

(6) One lesson in planting, cuttings, and root grafts. The students are given the approved tools and taught to perform the work in the manner that best economizes time and strength.

(7) Two lessons in pruning and covering grapevines. The first lesson includes the pruning and the second the covering. This work is usually done in the garden greenhouse with vines taken up in autumn and stored in the cellar.

(8) Two lessons in spraying and the use of spraying tools. The students are first given instruction in different kinds of spraying tools, and are required to take at least one of the pumps apart, pack it, and put it together. Next they are given instructions in spraying, either out of doors or upon the trees in the garden greenhouse. Our students in horticulture have previously had instructions in compounding insecticides and fungicides.

(9) One lesson in the use of the stapling machine in making berry boxes. The students are taught how to use the machine, and they are expected to use it one at a time as opportunity occurs.

(10) One lesson in packing apples. A model apple barrel is filled with apples and pressed with the approved appliances.

(11) Two lessons in outdoor pruning. These lessons are put in at times when the weather is favorable for outdoor work.

(12) Two lessons in describing apples. The descriptions of the leading pomologists are studied and the points for description are noted, after which written descriptions are made of certain varieties.

(13) One or two lessons in judging apples. This lesson necessarily depends somewhat on the stock of apples available. Sometimes apples are so high priced in our markets that we feel obliged to omit it.

(14) One lesson in packing plants for shipment by the most approved methods and appliances.

In addition to the above, our students in horticulture are given work in the greenhouse as follows:

(1) One lesson in making a propagating bed. Each student makes a small propagating bed, in which he afterwards carries on the operations of propagation.
(2) One lesson in making and planting soft-wood cuttings.
(3) One lesson in preparing earth beds for vegetable culture in winter.
(4) One lesson in sowing seeds.
(5) Two lessons in pricking out plants.
(6) Two lessons in transplanting plants. This work is generally performed in our garden house, and includes planting out small plants, as cabbages, strawberries, etc., with the most approved tools by the most approved method.
(7) One or two lessons in preparing vegetables for market.
(8) Two lessons in potting plants.
(9) One lesson in shifting plants.
(10) One lesson in treating greenhouse plants for insects and fungi.

The work in the greenhouse is interspersed with the laboratory work as convenience dictates. Our students in horticulture are almost all in attendance during the winter season; hence most of our work is necessarily performed indoors, but we find our garden greenhouse, which is simply a greenhouse inclosure, without floor, benches, or center roof supports, a most convenient and practical addition to our equipment for instruction.

L. C. Corbett, of West Virginia, read the following paper:

Systems of Record Keeping in Experimental Horticulture.

A uniform system of note filing, simple yet complete, for station use, is each year becoming more and more of a necessity. As the work takes new divisions and becomes more continuous in its character, a very different problem is presented than that of the annual experiment. In extended work covering a series of years, the exact or even approximate requirements of any division of the work can not be foretold. Hence the necessity of a flexible or expansible note file. The first thing to suggest itself along this line is the card system, or something of a like nature, in which the cards are replaced by slips of convenient size. This is certainly a decided advance over the common ruled notebook and ledger system, in which several entries must be made in various parts of the same book, if it be of any considerable size. Then these large ledgers or journals are unwieldy, they can not be carried into the field, and are therefore merely interpretations from the actual field notes. In the work of transcribing, error is almost a certainty, for no matter how careful or accurate the workman, the change of an adjective or the omission of a punctuation mark may be sufficient to alter or even absolutely reverse the meaning of a sentence.

One of the prime objects, then, is to avoid the necessity of copying from one book to another. If there were no other advantages to be gained, the lessened cost of record keeping would in itself be sufficient to claim careful attention.

Another aim in view is a system of note filing which shall be without limit, and which shall not have that objectionable feature of the slip system—the loss or misplacement of slips.

In order to overcome the necessity of rewriting notes, the books or pads used must be made of a size convenient for the pocket and, therefore for use as a field notebook. This requires the use of a somewhat smaller sheet than would otherwise have been adopted. The slip used, which is 4¼ by 7½, is convenient for holding in the hand in making entries and for carrying in the ordinary sized coat pocket, and it is yet large enough to contain all the necessary data relating to the (behavior) and yield of farm or garden plants during a single season, and as a new book is used for each year's work the size of the book never becomes unwieldy. Each experiment, if it be one of considerable extent, is given a separate book, or if there be a number of coordinate lines of work under one general head, these are all brought together in a single book.

This is, in reality, a combination of the loose slip and book form of note filing. The advantages of this scheme are almost without limit, as compared with any other plan now in use.

It possesses all the best points of a slip system, in that a special ruling may be had for any line of work in hand. The number required will determine whether they are to be printed on the ordinary job press or whether a mimeograph copy is to be made. The use of the mimeograph I have found to be a most convenient and labor-saving aid in ruling slips for special experiments. For general variety tests, either with farm, garden, or fruit crops, a set of printed blanks can be easily devised which, used in combination with blank slips as interleaves, furnishes one of the most convenient forms conceivable.

Another point possessed by this form is its flexibility. By that I mean not only its power of expansion, but that of contraction as well.

To illustrate: If in the course of an experiment a page becomes torn or soiled and it is desirable to replace it, the clips can be loosened and a reproduction of the slip be placed in its stead; second, if the book was not made with sufficient space for the work in hand, new forms or blank pages can as easily be added, or transferred from one book to another.

As a pad for field use it is convenient for writing upon, as it is of a width easily grasped by one hand while writing with the other; the back cover is made of heavy board, to give a firm writing support, and the flexible cloth stub allows of almost unlimited freedom for folding back leaves not in use, as well as overcoming the annoyance of wearing and tearing out, experienced in the use of the heavy, manila, detail paper without cloth stubs.

The front cover is made of a lighter piece of cardboard, and provided, like the back cover, with a flexible cloth stub.

For binding thin books, the staple used in binding pamphlets of all descriptions is found to be most convenient, but for thick books the brass binding staples or tacks are found to work best.

If it were known at the time of making a book, that no changes would be made, it might be sewed together, but the use of the clips and staples allows of loosening the covers and bringing together in a single book the observations upon any variety or subject, during any series of years, so that the work of collating data for reproduction in bulletin or tabular form is a simple matter.

To illustrate, suppose we have an orchard of forty varieties of pears. This year I have a single book with one or two leaves devoted to each variety, and so on, in succeeding years, for fifteen or twenty years. Then I desire to bring all the notes upon each variety together. The books have all been uniform in size and in style of blank used. I have only to loosen the clips of my fifteen or twenty books and bring together in separate books, or in a slip file, the loosened leaves, and I have the thirty pages relating to Nos. 1, 2, 3, etc., either arranged in series, by years, in a slip file, or rebound in books, using a book for each variety, and by way of suggestion I should say that at the end of each period of years, be it two, five or ten, as the case may be, books should be made containing all the slips bearing data upon any particular subject or variety.

All books of whatever character should be carefully and plainly indexed upon the outside cover, so that when filed, those bearing upon related subjects can be placed together.

I would further suggest the use of this, or a like form, for constant use as a pocket scratch book, so that any note taken in the course of travel or of inspection may fall into its proper file, and when the general book-making period comes around, they then find a permanent home.

A temporary file is necessary for miscellaneous notes, and for all slips before they are prepared for binding. As has been suggested, all outlines and all preliminary data, such as the name of experiment, variety name and number, where plants and seeds were obtained, etc., is written upon the slips while in this temporary file and before they are bound into books, but all are made into books before they are required for use in the field, to prevent loss, misplacement, and duplication.

The temporary file used consists of a drawer or box of convenient depth and width for holding the strips when standing on edge. The slips relating to various subjects are placed in folders made of heavy, manila, detail paper, and folded so that one cover is about three-fourths of an inch shorter than the other, to allow of ready inspection of the title written upon the contained slips.

Recapitulation.—In this system we have—

(1) All the advantages of the loose-slip system.

(2) When bound we have the convenience of a flexible-backed pocket notebook.

(3) At no time does the plan prevent additions, deductions, or combinations.

(4) No duplication or copying is necessary, if full field notes are taken.

(5) The blank and printed or mimeograph slips allow of endless modifications and combinations, so that although the slip, per se, is small, ample space can be provided even for the most extended observations. If necessary, slips that are a multiple of the type size may be used as folders where maps or charts too large for a single sheet are necessary. In this way the scheme may be accommodated to nearly all requirements of private or experiment-station work.

The form of blank to use.—The form of blank to be used must be determined by the use to which it is to be put and the peculiar conditions under which it is to be used, and so designed as to accommodate the greatest variety of plants and experiments. The printed matter must therefore be limited to general heads, rather than extended to detail. The detailed form for any particular plat or test must be provided by special ruling. I advocate the limited use of type or printed slips, and prefer special rulings. The printed forms are suitable for variety tests and a few cultural tests only. Other detailed matter is much better if not made to conform to a set plan, except in the case of notes on the influence of climate upon the behavior and growth of plants.

Until some general and uniform plan is provided for studies of such character we can never arrive at any satisfactory conclusions regarding the general effect of exposures, varying degrees of temperature, and humidity upon our common plants. Yet this appeals to me as one of the most interesting lines along which cooperative experiments can be conducted, and it is my purpose here and now to ask all horticulturists present who are willing to cooperate along this line to give me their names, and before another season opens up I will provide them with the necessary blanks, in order to insure uniform and concerted efforts along the lines that seem to suggest themselves as most important.

In a few far-reaching cooperative lines of work, like the one suggested in variety tests, I am inclined to favor the adoption of a uniform system of note taking by the several stations, but when the problem is that of cultural methods, or other original lines, no set plan, except it be designed for the particular work in hand, will ever suffice.

The discussion following the paper disclosed about as many systems of note taking as there were persons taking part in the discussion.

A paper by E. G. Lodeman, of New York, on the "Position of botany in horticultural education," was read by L. C. Corbett.

Upon motion of L. C. Corbett, a committee was appointed to consider the question of providing a bureau of plant registration. The committee appointed consisted of L. C. Corbett, of West Virginia; W. A. Taylor, of the United States Department of Agriculture; L. H. Bailey, of New York; F. S. Earle, of Alabama, and C. H. Shinn, of California. The objects of such a bureau were stated to be (1) to prevent duplication of names and the renaming of old sorts; (2) to form a national herbarium of economic plants; (3) to simplify nomenclature; (4) to aid the student of varieties and variation under cultivation; and (5) to secure to the originator his discovery as is now done for the inventor. It was generally considered that such a bureau should be attached to the Division of Pomology of the United States Department of Agriculture.

The section appointed a committee on seed testing, consisting of G. McCarthy, of North Carolina; F. W. Rane, of New Hampshire; and G. H. Hicks, of the United States Department of Agriculture, which was made a subcommittee to the one appointed in general session of the convention (see p. 63).

SECTION ON ENTOMOLOGY.

Three meetings of the section were held November 10, 11, and 12, 1896, in the office of L. O. Howard, Chief of the Division of Entomology, United States Department of Agriculture, O. Lugger, of Minnesota, presiding. In the absence of the secretary elect, W. G. Johnson, of Maryland, was appointed temporarily to this position.

After a discussion of the need of better legislation against noxious insects, on motion of W. B. Alwood, of Virginia, a committee of three was appointed by the chair to further consider this matter and report at the next session. The committee appointed was: W. B. Alwood, L. O. Howard, and W. G. Johnson.

The chair called the attention of the section to the sale and manufacture of various bogus insecticides. It was the general expression of the members present that some action should be taken to suppress these frauds.

In the absence of the author, L. O. Howard read a paper entitled, "Notes from Auburn, Alabama," by Carl F. Baker, of which the secretary has made the following abstract:

Cotton and corn have been very free from insect injury the present season, the greater part of the damage to these plants being done by fungi. The scarcity of the bollworm in corn was very conspicuous. *Protoparce celeus* and a species of *Dicyphus* var. *vestitus* reported common on tomatoes. The larvæ of a Plusia, probably identical with *P. brassicæ*, was found abundant in the college greenhouse. It was parasitized by a Copidosoma. The Southern army worm (*Laphygma*) was reported as having done much damage to Bermuda grass lawns. The cucumber moth (*Margaronia hyalinata*) and the ailanthus worm (*Oeta compta*) were quite common. *Gelechia cerealella* and *Plodia interpunctella* were numerous in granaries. *Agraulis vanillæ* was reared on *Passiflora incarnata*, and *Terias nicippe* on *Cassia occidentalis*. A Scolytid was bred from dead twigs of fig. A Sesiid was reported as boring the twigs of the black locust, doing much injury. A geometer was bred from larvæ on pokeberry which had defoliated this plant. An Anthribid beetle was reared from peaches killed by *Monilia fructigena*. A small moth, resembling the one becoming injurious to peach and some varieties of apple in Colorado, was also bred from these peaches. The author was of the opinion that this moth would appear elsewhere soon, as infested fruit was being shipped out of Colorado in considerable quantities. *Copris gopheri* was reported to have been taken at lights.

In the discussion which followed this paper, E. A. Schwarz, of the United States Department of Agriculture, furnished the secretary with the following: The occurrence of *Copris gopheri* in Alabama was of considerable interest, since gopher insects were hitherto recorded only from Florida, but before accepting this fact Mr. Schwarz said he would like to see specimens from Alabama, since the smooth forms of our common Copris were likely to be mistaken for *C. gopheri*. Dr. Hamilton's recently published statement that *C. gopheri* had been attracted to lights in a house at Sanford, Fla., was also alluded to.

F. A. Sirrine, of New York, read a paper on "Termites (*T. flavipes*) as a forcing-house pest," and has furnished the following abstract: These insects were found injuring chrysanthemum plants in forcing houses at Floral Park, N. Y., during the month of August, 1896. The injury consisted in the gnawing of the bark from the plants just below the surface of the ground, and mining the center of the stems. Bisulphid of carbon was successfully used for their destruction, but the writer said more plants were injured by it than by the Termites. The same author referred to some experiments he had performed during the winter of 1894–95 and 1895–96 with cocoons of *Melittia ceto*. He said moths from cocoons buried in a sandy loam to a depth of

four inches were unable to reach the surface. Checks were conducted at the same time each year by placing cocoons on the surface of the ground and covering them with cheese-cloth-covered lantern globes.

Mr. Sirrine stated also that in 1894 the potato growers of Long Island became alarmed about what they called "pimply" potatoes. In 1895 buyers reduced the price 5 cents per bushel on account of this pimply condition of the tubers. During the same year F. C. Stewart gave the subject careful study and decided that the trouble was due to some insect injury. The present season, 1896, Mr. Stewart continued his observations, and in July found minute white grubs boring into the tubers. He also found pupæ in the soil about the potatoes. Both the larvæ and pupæ were sent to Mr. Sirrine, who bred the potato flea-beetle, *Epitrix cucumeris*.

The next paper was by W. G. Johnson, entitled "Experiences with white muscardine and the chinch bug." The author gave a careful review of some of his observations in the field and laboratory with the so-called chinch-bug disease while he was connected with the Illinois State Laboratory of Natural History. Reference was also made to some work of B. M. Duggar, who had charge of the insect disease investigations in Illinois from June, 1895, to June, 1896. It was shown that the action of this disease upon chinch bugs in close confinement, under the most favorable conditions, was very slight, and that the death rate after inoculation was scarcely over 10 per cent. The writer stated that the same fungus was almost universally present on a large variety of species of insects, and that it does not seem to increase to any appreciable extent by artificial distribution. It was also shown that it will grow more profusely on insects immediately after death, when killed in hot water or otherwise, than on the living. In view of these facts, the author recognized the fungus as a facultative parasite and a slight natural reducing agent of insects, but, beyond this, experience did not lead him to claim for it any economic value whatever.

In discussing this paper W. B. Alwood said the chinch bug had been quite bad in Virginia, and that he had attempted to propagate this same fungus for distribution, but failed. He said that not over 10 per cent of the chinch bugs in his infection cages showed any fungus growth. O. Lugger said about 45,000 boxes of this fungus were sent out from his office the present season, but that the reports of success and failure were very confusing.

The report of the committee on the need of better legislation against noxious insects was unanimously adopted and referred to the executive committee of the Association (see p. 59).

That portion of the report of the committee on nomenclature relating to entomology was read, unanimously adopted, and referred back to the executive committee.

Mr. Alwood then read a paper on the "Dissemination of the San José scale in Virginia," of which he furnishes the following abstract:

The San José scale was first discovered in Virginia in 1893, at Charlottesville, where it had been introduced on nursery stock from New Jersey. This for some months was thought to be the only center of infection in the East, but a little investigation soon showed the source of the infested plants, and then the scale was rapidly located at different points throughout the entire Atlantic coast region. Diligent inquiry through ordinary methods only succeeded in locating the scale at one other point in the State during the next two years, viz, at City Point, where several thousand infested trees from New Jersey had been planted and an orchard of 18,000 trees become involved. But after the passage of the Virginia scale law giving ample police powers, systematic inspection was begun, with the result of locating ten different infested premises in the first two days' work. The inspection work was continued during the summer of 1896, and it is now thought that most of the infested places are known.

A map was exhibited showing that there are now known to be thirteen points of infection in the State, including some nurseries, not counting the infested premises of each individual. Of these, three are in the great Valley, six in the Piedmont, and six

in Tidewater. Most of these are widely separated from each other and only two or three can now be considered serious. The history of each case has been carefully looked up, and in every instance the insect was introduced on nursery stock from without the State. New Jersey was said to have been the chief offender, but it was intimated that Maryland, Georgia, and Louisiana had each sent infested stock into the State.

The powers given the inspector by the Virginia law are found to be ample and the people, quite generally, cooperate readily with the officers; but the lack of specific funds for carrying on the work is an almost total defect and will prevent accomplishment of much necessary work in the way of clearing up a few seriously infested premises where the owners do not seem to realize the danger which threatens the fruit industry.

W. G. Johnson then reviewed the present status of the San José scale in Maryland, stating that every infested locality and nursery in the State had been personally inspected by himself since the 1st of August in accordance with the tree and nursery-stock law. It was stated that the scale had been definitely located in 12 counties, including three nurseries, and in no case had been completely exterminated, except where its attack was confined to one or two trees. The speaker further stated that he was of the opinion that the pest never could be completely suppressed on account of its wide distribution and firm foothold in Maryland, but could be kept in check by persistent and energetic fighting by a thorough and harmonious State organization on the part of the nurserymen and fruit growers. Speaking of the potash-lye whale-oil soap for its extermination, he said this wash was very much more satisfactory than the old soda-soap wash, but that it was too expensive, and a cheaper wash must be found that would answer the same purpose. Trees treated last fall with whale-oil soap at the rate of 2½ to 3 pounds to a gallon of water were this season literally covered with the scale. Mr. Johnson said he had now under way a series of experiments with various combinations of kerosene emulsion and whale-oil soap, the cost of washes varying from 4 to 8 cents a gallon. He also stated that R. S. Emory, one of Maryland's most successful fruit growers, had purchased 5,600 pounds of the potash-lye whale-oil soap this season, and had already used about half of it on his scale-infested trees. He said Mr. Emory was very much more pleased with this soap than he was with that made with soda. It is easier to apply and more effective. The speaker said Mr. Emory was not thoroughly satisfied, however, with the soaps, and was of the opinion that some entomologists placed too much confidence in them for the destruction and suppression of the San José scale. The author said he agreed with Mr. Emory on this point.

A paper entitled "Economic entomology in North Carolina," by Gerald McCarthy, was read by L. O. Howard, in the absence of the author. [Abstracted by the secretary.] From the botanical standpoint, the author said, the State had been pretty well covered; while the entomological side, in a large part, still remained unexplored. Briefly outlining the entomological work of the year, he said *Phorbia brassicæ* was very destructive to young cabbage along the coast region early this season. Tobacco decoction and crude carbolic acid applied to the soil around the plants gave the best results. The cotton caterpillars Heliothis and Aletia were present. The Northern army worm was reported this spring. The chinch bug was also seen in isolated spots. The imported elm-leaf beetle was also found on elms in one town. *Lina scripta*, the Western cottonwood beetle, was also found on Carolina poplar and cottonwood. *Gelechia piscipellis* was found mining the leaves of tobacco. The bull or horse thistle, *Solanum carolinense*, seems to be its normal host. This same leaf miner is also reported from Florida as injuring tobacco. No satisfactory remedy has yet been found. The following scale insects were reported: New York plum scale, convex scale, gloomy scale, San José scale, oyster-shell bark louse, scurfy scale, euonymus scale, and privet scale. The euonymus scale was found a difficult one to combat. The gloomy scale was confined to silver maple, and very destructive. The writer stated that the State Horticultural Society had instructed him to draft a law against fruit pests, to be presented to their next legislature.

In the absence of the authors, L. O. Howard read a paper on "Some results of recent studies of grass-feeding Jassidæ," by Herbert Osborn and E. D. Ball, and has made the following abstract:

In this paper the authors refer to the previous publications of the senior author on the subject of the damage done to pastures and lawns by the leaf-hoppers of the family Jassidae, and show that while it has been indicated that the loss must be enormous, the insects appear to a great extent to be destroyed by the use of a tar pan or "hopper-dozer." Up to the present time, however, our knowledge of the life histories of the species involved has been too meager to furnish a certain basis for remedial measures. The present paper determines the life history of a number of species, the range of their food plants, especially in the larval stages, and a study of the specific limits of a large number of species.

More or less detailed consideration is given to the following species: *Tettigonia bifida, Diedrocephala mollipes, D. noveboracensis, Gypona octo-lineata* Say=*flavilineata* Fitch, *G. bipunctulata, Xestocephalus pulicarius, Xestocephalus* n. sp., *Neocoelidia tumidifrons, Dorycephalus platyrhynchus, Hecalus lineatus* Uhl., male=*H. fenestratus* Uhl, *Parabalocratus viridis, Platymetopius cinereus* n. sp., *Deltocephalus debilis, D. inimicus, D. melsheimeri, D. sayi, D. configuratus, D. albidus* n. sp., *D. inflatus* n. sp., *D. reflexus* n. sp., *D. pectinatus* n. sp., *D. abbreviatus* n. sp., *D. compactus* n. sp., *D. signatifrons, D. weedi, D. sylvestris* n. sp., *D. oculatus,* n. sp., *D. minimus* n. sp., *Athysanus curtisii, A. bicolor, A. obtutus, A. comma.*

The second paper, "On the use of steam apparatus for spraying," was read by the author, Dr. L. O. Howard, who also furnished the following abstract:

The speaker, after a brief historical account of the development of hand apparatus for spraying insecticides, considered in detail some twenty machines which have been constructed since 1882, which spray by steam power, showing that a thoroughly efficient apparatus of this kind can be constructed for from $250 to $300. Not only were the especially constructed machines described, but also several makeshift apparatus which utilized the services of ordinary watering carts and road engines and steam fire engines. In conclusion, he expressed the opinion that such apparatus will seldom be constructed by the owners of even large orchards for their own individual use, but that for community orchard work they are valuable and will come more and more into use, while the professional sprayer, an individual who is bound to come to the front, will use steam-power machines. Perhaps the greatest value which they possess, however, is for work on shade-tree insects in cities and larger towns. The time is coming when every city which takes a pride in its shade trees will possess one or more of these machines.

Mr. Alwood offered the following resolution, which was unanimously adopted:

Whereas in consideration of the recent alarming spread of the San José scale in the Atlantic and Middle States, and the further fact that we believe its suppression can only be accomplished by carefully framed laws, which should be enacted in the several States: Therefore be it

Resolved, First, That the Section of Entomology of the American Association of Agricultural Colleges and Experiment Stations indorses the principle of special legislation for the suppression of this pest;

Second. That a committee of ten be created, with L. O. Howard, Chief of the Division of Entomology, United States Department of Agriculture, as chairman, which shall carefully prepare such memoranda as they deem best in relation to legislation dealing with the pest, and when so prepared this matter shall be submitted to the authorities of the several States concerned for such action as the legislatures thereof may choose to take.

Third. That it is the sense of this section that State inspection for the control and prevention of the dissemination of this pest upon nursery stock is imperative.

The chair appointed the following committee: L. O. Howard, W. B. Alwood, W. G. Johnson, F. A. Sirrine, J. B. Smith, J. A. Lintner, F. M. Webster, G. G. Groff, A. D. Hopkins, and G. H. Powell.

SECTION ON MECHANIC ARTS.

Two sessions of this section were held in the parlors of the Ebbitt House, November 10 and 11, the chairman, J. W. Lawrence, of Colorado, presiding.

The first paper read was one by E. Kidwell, of Michigan, entitled, "Requirements for the proper government of an educational institution." This paper provoked sharp discussion, the criticisms of governing boards of these institutions being vigorously combated.

A paper on "Experiments with an air-lubricated journal"[1] was read by A. Kingsbury, of New Hampshire.

The following paper was presented by R. H. Thurston, of New York:

Education in Mechanical Engineering and the Mechanic Arts.

Education in mechanical engineering and the mechanic arts, or, in other phrase, the professional education of the mechanical engineers and the industrial education of the practitioners of the arts and trades which underlie that which is coming to be recognized once more as one of the great, and even, as thought by many, the learned professions, may be truly asserted to be, to-day, among the great problems, industrial, social, and even moral, of our time. The great questions propounded at every gathering of the associations of professionals and of practitioners is, and probably must always hereafter be: What are the precise purposes of such education and training? How should they be attained? By what methods and to what extent should education be carried on? What is the best practice to-day? How can the best contemporary practice be improved? What may be taken to constitute the highest efficiency in the operation of such systems of education and training? How may maximum efficiency be attained?

It may be safely asserted that, before attempting to answer with fullness and exactness such questions as these, it is essential that a clear understanding be had of the meaning of terms and the limitations of the field in which we are prospecting. As a basis of discussion in this paper, the following preliminary definitions are made as representing the ideas to be formulated in advance of such discussion:

The art of engineering is that of planning all constructions, of designing all works which are the product of the mechanic or constructive arts. The profession of engineering is that which includes those men whose learning, experience, and ability fit them for the successful practice of that vocation.

The requirements of the practitioner to-day are vastly higher than a generation ago, or in earlier times. The humblest member of the profession, quietly and unobstrusively doing his work, unnoticed and unrecognized by the world, and even, perhaps, by his own colleagues, is required to possess more learning, and a greater practical power of accomplishment, than did the men who were deified by the old Greeks, or those who became famous in the days of Archimedes, or of Michael Angelo, or even of James Watt and Papin. He is necessarily familiar with the nature, the essential characteristics, the methods of production, and the costs of all the available materials of construction; he must be able to employ these materials in the best manner, in the most exact proportions, and with due regard to expense, in any form of construction falling within his field of work. He must be competent to design a required machine or a static construction in such manner as to insure that it shall give the demanded output or result, in good proportion, and with minimum total cost per unit of product throughout the life of the machine or construction, and including costs of maintenance and of replacement.

[1] This paper has been published in Jour. Amer. Soc. Naval Eng., 9 (1897), No. 2, pp. 267–292.

The contemporary practitioner in engineering and his successors are expected to have a school and college training which shall include mathematics and the sciences, in so far at least as they bear upon the work of the profession, and the languages so far as they give him access to modern engineering literature. The requirements for admission to our advanced technical schools and colleges are now higher than is usual with schools of either law or medicine, and the courses of instruction are certainly not less extensive, complete, and exacting. Thus, a law school, of which the entering requirements lie before the writer, demands, when its students enter by examination, the following:

"Candidates for a degree are required to pass an examination in arithmetic, English grammar, orthography, English composition, geography, English and United States history, civil government, plane geometry, and first-year Latin. One year of French or German will be received as an equivalent for the Latin required, and substantial equivalents may be offered for other subjects."

Those entering the engineering schools of the same institution are examined in English, geography, physiology, American history, arithmetic, plane geometry, algebra, solid geometry, advanced algebra, plane and spherical trigonometry, and French or German, or both languages. Some schools demand Latin at entrance. The course of study for the latter is then continued for the four years; that of the law school covers two years, so called, of nine months each. Anyone may enter the law school direct from the high school, and take a place in the so-called "junior" class; while to attain the same rank in the engineering schools, the academic course must be supplemented by two years of exceptionally hard work in the study of mathematics and the sciences.

The lawyer thus enters, after a comparatively easy course and a short one of college work, into a "learned profession;" the engineer, obviously by far better right, is entitled to claim for his the rating of a still more truly learned profession. President Jordan was undoubtedly right when he, perhaps the first among academic college workers, gave currency to the claim that engineering is in fact the only truly learned profession, since it deals constantly with real learning and bases its work absolutely upon scientific truth.

The professional training of the mechanical engineer, however, involves much more than the simple education of the man in the scientific principles which are in the design of machinery. It includes, or should include, so much of knowledge and training in the arts subsidiary to engineering as will permit the designer to intelligently provide for the best construction, and also to supervise the work of construction, erection, and operation, so far as may be essential to the economic success of the work. The practitioner must not only be able to give the parts of his machine proper form and proportion, but should be competent to see just which of various materials is best for his purpose; what modification of form is dictated by the difficulties and exigencies of construction in the shop, and what influence the costs and the methods of the trades employed in the construction should have upon the proportions and the forms of parts, as well as upon the choice of their material. Thus it is important that the arts and trades subsidiary to the profession of engineering should be in large degree familiar to the trained engineer.

The mechanic arts and manual training thus come within the limits of operation of the engineering school, as well as constitute the field of the schools of mechanic arts and of the manual-training schools of more elementary character. But professional training in engineering, instruction in the mechanic arts, and manual training are, nevertheless, three essentially distinct subjects of technical-school work. Manual training does not necessarily involve trade-school work; nor does the trade school necessarily touch engineering proper. Yet engineering involves a knowledge of the trades, and the trade school necessarily gives instruction in manual training. These distinctions, once pointed out, are self-evident; but their recognition is not always obvious in the arrangement of technical-school work. Perhaps the following may be taken as correctly stating the definitions of the terms thus found nonsynonymous:

Manual training teaches simply the use of tools, and mainly for the purpose of developing the skill of the pupil, and of awakening within him dormant powers, perfecting his symmetry of character and of attainment, and giving him command of an always latent talent in such manner as to add to his ability to make the most of his after life. It has no necessary reference to any trade; but confines itself, in its proper field, to the conferring upon the pupil that sleight which makes tool using a main characteristic of the human animal only. What shall be done with the tool after its use becomes familiar, and skill in using it is acquired by intelligently directed practice, is not a matter which concerns the manual training school teacher. He is making a better boy or girl or man, not teaching a trade.

The trade school, the school of mechanic arts, teaches the pupil the methods of a trade, the purpose of which trade is to make a certain defined class of products, as houses or furniture, horseshoes or chisels, steam engines or boilers, electric motors and generators or hydraulic turbines. The practitioner is a carpenter or a pattern

maker, a molder or a smith, a machinist or a brass worker. Instruction in the trade school makes the manual training of its pupils, their instruction in the use of tools, subsidiary and directly contributory to the art which is taught, to the trade which is practiced by its graduates. Its main and ultimate purpose, however, is to instruct in the methods of the trade, and to make the pupil a skilled workman in that particular vocation. Our public schools, in the large cities, often have manual-training schools attached to their academic departments; they are purely gymnastic schools. The great cities of Europe, and especially of Germany, have schools of the trades, often supported largely by contributions from the trades unions. The two classes of schools have thus distinct purposes, and consequently distinct methods of instruction.

Manual training, like the pure mathematics, is instruction for the subjective purpose of improving the pupil; trade instruction teaches the use of the same tools for the purpose of enabling the pupil to produce some useful construction. In the former the use of the tools as gymnastic apparatus is the primary object; in the latter the tool is used as a means to another end, and is simply accessory and subsidiary to the purposes of the trade.

But still another distinction must be observed. The workshops of the engineering school have a purpose distinctly different from those of the trade schools, as well as from those of the manual training schools. The end sought is not the production of a skilled mechanic, primarily, but the familiarizing of the pupil with the use of tools in the various trades subsidiary to the work of the engineer in such manner that he may design intelligently, insure proper construction, and criticise work performed under his contracts with justice and accuracy. It is, like the professional work in which he is taught to take part, a beginning of practical acquirements which he is expected to advance upon, and to continually perfect himself in throughout his professional career. He is not made a mechanic any more than an engineer, but the novice is started along a path which he may traverse with steady gain as long as he maintains his hold upon life and work.

The engineer as designer produces plans for construction which involve the making of patterns in the pattern shop, and other constructions in wood, which demand the services of the molder and of the smith and of the machinist. He can not decide upon the materials or the proportions best suited for any given detail without some knowledge of the methods of work in these shops and until he can, in his mind's eye, see each piece throughout its complete course into and through the pattern maker's shop and the foundry, or the blacksmith's shop and the machine shop, and into its place, finally, in the complete machine in the erecting shop. If he does not know whether to employ cast or wrought iron, or steel, or brass, or bronze, and just how to construct a pattern that will "draw," how to lay the grain of the iron in a forging, how to choose the material for either casting or forging, and how to decide whether a smooth-hammered or a rough-forged rod or crank or bar is, on the whole, likely to prove best and cheapest, he will certainly fail often, as the most experienced do occasionally, and will find himself called into one or another shop to witness the difficulties, troublesome always, often insuperable, and invariably more or less expensive, which his lack of knowledge and foresight have produced. Thus the purpose of the trade schools, as incorporated in the scheme of the engineering school, is the instruction of the young engineer in the methods and practice of the arts subsidiary to engineering with the ultimate and main object of enabling him to design and to inspect intelligently. Incidentally he becomes possessed of, usually, as much skill as the ordinary apprentice—sometimes, indeed, of more—as a consequence of the systematic methods of instruction adopted, and thus has not two strings, but a number of strings, to his bow, and may, after a time, earn a living at any one of the several trades taught him to this extent.[1]

The engineer as designer also requires a practical acquaintance with the purpose and the method of operation of the machine to be produced, and a familiarity with the conditions surrounding it and affecting its working, which can only be had after practice and observation have shown him clearly what are the exact qualitative and quantitative limiting conditions, what are those which conduce to efficiency, and what to exaggeration of wastes of power and capital. This, in most cases, can not

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[1]As the writer has elsewhere remarked: "In a well-equipped school and with able teachers, the progress of the young man who is naturally well suited to the work is extraordinarily fruitful and rapid;" in fact, it is so fruitful and rapid that the writer has been criticised severely for a statement which might have been made still stronger and more impressive without exaggeration.

As Mr. Outerbridge has remarked: "Manual training as a starting point in the education of the mechanical engineer is a scientific invention and intellectual discovery worthy to rank with many other original inventions of the age, and is destined to produce equally beneficial results in the future."

be acquired in the shops and laboratories of the college; but his habits of observation and of effective manipulation, acquired in those practical departments of his college work, fit him to grasp the situation, and to weigh and measure such conditions promptly and accurately, when on entering into business he is called upon to start in on his final stage of apprenticeship as a designer. In fact, one of the most fortunate aspects of his training is seen in the power conferred upon him of quickly and thoroughly fitting himself into a new situation.

The designer must be competent to compute dimensions and to decide upon the best forms of details of his proposed constructions, as well as to plan the machine, as a whole, for a particular purpose and for maximum efficiency. This constitutes "mechanical engineering" in its accepted and restricted sense, and the profession of engineering takes for its special field of work, for its vocation, that of planning constructions. Highest efficiency is attained when the plans produced are such as will supply to the proposing purchaser and user apparatus which will give him highest returns for a unit of capital expended upon it and expended in its operation and maintenance and final replacement. This will be attained when the machine is so formed and proportioned as to most perfectly do its work, with least cost for satisfactory construction, and with minimum operating expenses, including indirect as well as direct outgo. This, in turn, will be assured when the designer is familiar with the nature, costs, and special adaptations of the materials available, can compute the forms and proportions of details with the result of acquiring the best forms for practical operation and the exact proportions giving uniform strength and minimum volume and weight consistently therewith, and when he understands the art of practically applying that knowledge of his materials, of applied mechanics, and of details of mechanisms to the specific case in hand. Education in mechanical engineering is thus to be directed, as its main purpose, to the instruction of the novice in the theory and art of design from the points of view of both the constructor and the capitalist.

The higher work of the engineer and of the advanced engineering school leads from the stage just described onward, upward, and into the theory and art of construction of completed machines; and this involves, necessarily, some selection, which selection often takes the form of specialization. It is not practically possible to go about the design of all the familiar and standard forms of machines in the comparatively short period of time available for instruction in the upper classes of even the most advanced engineering school, and the schedule of work must be restricted to a few typical machines. As selection must occur, in any case, it is not at all objectionable that this selection should take the form of a real professional specialization, and the student and pupil thus turn his attention largely, if not mainly, to the study, for example, of steam engines, of railway machinery, of electric light and power machinery. In such cases, the machinery selected for study becomes naturally and effectively the illustrative exemplar of the application of the principles of design previously discussed and the embodiment of the theory and the art of general mechanical engineering construction.

But it should be further observed that the higher work of the advanced courses in mechanical engineering, and even in courses of instruction in mechanical arts and real trade-school work, may and often must involve the highest of all scientific work—that of research. In whatever branch of the education of the engineer, or of the mechanic, work may be done, it may be often found advisable and practicable to attempt the solution of problems which can only be attacked through the methods of scientific investigation and after a somewhat extended study of the laboratory methods of the chemist or of the physicist. Such, for example, are those relating to the qualities of the materials of construction—researches demanded alike by the trade school and the school of engineering and by the profession at large; such are those bearing upon the efficiencies of the systems of electric transmission, or on the economical operation of steam machinery and of other heat motors. This brings in not only the usual courses of instruction in the physical sciences, and the higher grades of this instruction, but also their most interesting and fruitful laboratory methods, and special developments of them by which they are peculiarly adapted to the purposes of the engineer. This constitutes to-day the most advanced work of the professional school in engineering. Work in this field has, during the last ten or fifteen years, produced a great advance in the practice of the profession, and the leavening of its practitioners of the older days and older school with the output of our later schools and more advanced methods and courses has brought about a spirit of ambition, of accuracy in its work, of scientific method, and in favor of exact determination of hitherto unknown facts and laws in the applied sciences of the profession that has favorably and enormously influenced the progress and standing of the whole profession. But a few years ago scientifically taught and professionally trained young men were not sought, and were even, in many cases, undesired, in many important establishments and by some of the leaders of the profession. To-day such men, if of the right sort, are welcomed by all, and anxiously sought by many, of our foremost manufacturers and professional men as valuable aids.

This constitutes the latest and highest development of the modern engineering school, and it has been so far developed in our own country as to have become a usual and matter-of-course part of the contemporary curriculum.[1] Where graduates return, as is now coming to be a frequent occurrence, to secure special and advanced instruction in the lines of professional work taken up by them after leaving college, laboratory methods of engineering practice, and particularly scientific investigations of problems which have come to them in the course of their practice in design or in construction, almost invariably become an important, if not the major part of their post-graduate work. The schools which are sufficiently fortunate to be able to supply this class of instruction and to provide the requisite apparatus for such special researches are thus doing an important work in promotion of the progress now making, both in the development of scientific and fruitful and efficient methods in the work of the profession and in advancing it to at least fully equal rank with the older professions denominated "learned."

Schools of the mechanic arts, trade schools, are the great unsupplied need of our country to-day. The engineering schools are now so numerous and have such a hold upon the profession and upon the people that we need not fear their failure to do all that will come to them to do; but the trade schools are yet to be developed in this country. Engineering schools are now to be found in every State and, in many cases, have attained, or are rapidly attaining, a position and a prestige which must insure the full supply of the best and the highest instruction that the several States can demand. They have attained such a status and have such influence as will assure their progress at fully as great a speed as their constituency can appreciate and avail itself of; but the trade schools, needed for the systematic instruction of every poor man's son and of the great masses of our citizens, have as yet made no real beginning. Many trade schools are needed where one engineering school is required, and the task of their foundation and upbuilding is the greatest, perhaps, that presents itself to-day to the legislatures and the statesmen of our time and country.

Throughout the continent of Europe these schools have been doing their beneficent work for generations, and, of late years, with every facility that government and private means could together provide. They find great and valuable influence, and financial aid as well, coming to them from the trades unions and business associations, and are steadily advancing in Germany, for example, and in Switzerland, into a foremost place among the manufacturing nations of the world—which means, of course, among the wealthiest and most prosperous in all respects, moral, intellectual, and commercial. The tremendous extension of German trade into all parts of the world, and even into the home and foreign markets of the greatest manufacturing and commercial country, Great Britain and her colonies, is unquestionably due largely, probably mainly, to the influence of the German trade schools in the formation of a large body of skilled mechanics and a directing force of highly educated, and even learned, managers and manufacturing capitalists. The country of James Watt and of all early invention in the field of motive power and of textile manufactures is, at last, losing its tremendous lead of the past century, principally, as it may be probably safely asserted, through her comparative tardiness in the promotion of technical education, and especially of trade-school organization. Said John Scott Russell, away back in 1869, of his visit to Germany in 1849: "Twenty years ago professional duty took me to Germany for the first time. I can not forget my first impressions at the sight of whole nations growing up in the full enjoyment of systematic, organized, I might almost say perfect, education. I had already become acquainted with some theories and forms of education. I had read Plato's description of the perfect training for a nation. I was familiar with education in England, Scotland, and France. I was familiar with elementary school-teaching and had enjoyed the advantage of university education and the still higher education of the workshop. I was familiar with the system of Bell and Lancaster, having had personal acquaintance with its authors, and had myself taken an active part in schools of art and mechanics' institutions; but I confess to have been profoundly astonished—I may say humiliated—at the sight of nations whose rulers had chosen to undertake the systematic education of their people, and of people who had chosen to bear the burdens and to make the sacrifices necessary to obtain it. I do not know to what men or class of men in Germany the forethought, organization, and patriotism are to be attributed which made them lay aside personal ambition, political animosity, reli-

[1] The German commissioners sent to the United States in 1893 to report upon the technical education of this country and on the progress shown at the International Exhibition at Chicago considered this the most striking feature of our system of professional instruction. The chairman of the commission has informed the writer that its members have determined to use their influence, individually and as a commission, in favor of introducing some of its more valuable and, with them, unknown features into the system of German, and especially of Prussian, technical education.

gious sectarianism, and state parsimony in order to unite all classes of people in unanimous effort to raise every rank in society to a higher condition of personal excellence and usefulness and, by diffusing equality of education, to extinguish the most grievous of class distinctions."

And to-day Germany is, under a carefully adjusted and moderate protective tariff, finding full reward for her foresight and public spirit in the rapidly increasing wealth and intelligence of her people. She is even alarming the business men and statesmen of Great Britain by the rapidity with which her manufactured products are being sent into the markets of that country. She is compelling the respect and admiration of all countries by her progress in all the great industries. All this is, we may confidently assert, the outcome of her grand system of technical and trade-school education of her youth.

Our own country is especially favored by the intelligent quality of its people and their ready adaptation of their talents to the demands of the moment; but they have to-day no systematic instruction, as a nation, and our own task in the development of a true system of engineering, trade, and manual-training schools is, as yet, hardly commenced. Sooner or later, unless we perfect such a system promptly, it may be safely predicted our own country will suffer as Great Britain seems to be suffering to-day, by the relative gain of other nations, taught to produce by scientific and systematic methods, and thus enabled to excel in both the fruitfulness and the excellence of their skilled industries.

As the writer has more than once stated, in official reports and in private communications relating to this subject, "to educate our own people as well as the most favored parts of Germany, we should have 20 technical universities, with 50 instructors and 500 pupils each; 50 trade schools and colleges, with 20 instructors, at least, and 300 students each; 2,000 technical high schools, or manual-training schools, of 10 instructors and 200 pupils each, at the very least."

To educate the youth of this country properly and in such manner as to fit them effectively for their later work and to insure maximum prosperity to the nation, we probably ought to have to-day not less than 1,500 university professors, with 10,000 or 15,000 students under their care, studying the higher branches of technical work; an equal or greater number of college professors and students developing this work on a lower grade and preparing to fill the superior positions in the arts and manufactures of the nation; twenty or thirty thousand teachers engaged in the special trade and manual-training schools in the instruction of four or five thousand boys and girls proposing to become skilled workmen and efficient women. There are in this country not less than twelve millions of families, with at least eighteen millions of boys and as many girls, of whom one-half should be in the last-named class of schools; their education should cost about a half dollar in gold per capita, additional to the present taxes. The inauguration of such a system of schools for the people now constitutes the greatest and most pressing task of the statesmen and legislators of our country. Every citizen having sufficient intelligence to see where we and the world now stand, and having patriotism enough to induce him to give his aid in promoting the best interests of his country, will see in this movement his grandest opportunity.

W. S. Aldrich, of West Virginia, presented a paper on "Engineering experiment stations," an abstract of which is given below.

Engineering Experiment Stations.

Engineering experiment is coming to be required by the exigencies of business and the keen competition of trades at all related to engineering development. The increasing value of the work done by the testing departments of any of the large manufacturing concerns, as well as that now thoroughly organized and prosecuted by the principal railroad companies, has stimulated the development which comes of such research along many industrial lines. In addition to this, there have been many skilled experimentalists, trained in the laboratories of our representative technical schools, who have rendered invaluable service in advancing industrial development in many of the States where they have located. It is equally patent to all careful observers that the development of the foreign market for our manufactured products depends also upon the thorough organization and development of our industries and their utilization of the latest results of scientific research.

The advancement of engineering science and the promotion of engineering education are of similar importance in this relation. They alike demand attention to the newly developed instrument of service in the hands of the educator, the scientist, the engineer, and the manufacturer, namely, the research laboratory. Technical education alone is not sufficient to promote the development of engineering, mining, and manufacturing industries of the several States. On the other hand, the application of scientific method to all such lines of industry is now recognized as essential to their success.

The object, therefore, of such engineering experiment stations should be to promote scientific investigation, engineering research, and experimental testing in the chemical, physical, and economic sciences with special reference to their applications in the industries of life.

Such an experiment station should be established and maintained in each of our States and Territories. In this way its official testing station would come to be of great value to each State in developing its engineering interests and industries as well as in aiding its activity for the advancement of science and the promotion of engineering education in connection with such State college or university by the side of which it should become to be established.

Similar testing stations are found in connection with many of the German universities and technical schools, of which the parent organization is the Physikalische Technische Reichsanstalt at Charlottenburg, established in 1887. In fact, the twofold work of such experiment stations should be found along the lines laid down for the above Reichsanstalt, namely, (1) "the development of pure research; (2) the promotion of new applications of science for industrial purposes" The first division, or physical section, "has for its object the solution of scientific problems which present a practical or theoretic interest, and which necessitate the use of methods, apparatus, and duration of study which are beyond the command of individual investigators or schools of instruction. The second, or technical section, (Mechanisch-technische Versuchsanstalt), is under the management of Dr. A. Martens, and has for its object 'to develop the results acquired by the physical section, render them useful for practical purposes, and especially to test and rectify instruments of measure and precision.'"

While the smaller German testing stations are of more or less local importance they are still subsidiary to the Reichsanstalt, Berlin. The engineering experiment stations which it is proposed to establish in each of our States should partake alike of the local value and educational affiliations of these German testing stations on the one hand, and on the other, it is clear that we should have at least as fully developed a department as the technical section (Mechanisch-technische Versuchsanstalt) of the great national institution at Charlottenburg, Berlin.

"The technical section is divided into four subdepartments, each under the control of a chief, and supplied with all known apparatus and every facility for the prosecution of its work. The first of these departments is devoted to testing the strength of metals, chains, cordage, belts, woods, etc. The second department is devoted to testing building materials, such as natural and artificial stones, bricks, tiles, slates, wood, glass, lime, cement, mortars, pipes for water, gas, and sewerage. The third department treats of all forms of paper and textile fibers and fabrics; and the fourth department is devoted to lubricants."

Very much of the present commercial success of Germany is due to the characteristic thoroughness of her method of training. The details of every branch of business is carefully entered into. The manufacturer is ready to avail himself of the opportunities which the Government affords for thorough inspection, testing, and experimental determination of the value of his products. The official testing stations of Germany are continually in search of knowledge that will be of interest in some line of her national development and welfare.

Germany has been probably fifty years in preparing the way. It is to-day a great and successful nation. It has won as great victories in peace as in war. In both, the same methods have been pursued, namely, studious preparation in advance and the intelligent prosecution of scientific investigation.

German thoroughness, German methods, German patience and industry, German training and researches are commanding world-wide attention. The States, cities, and even villages nave given freely of their means to promote such industrial development. They are now earning their reward in the steady growth of their markets at home and abroad.

The engineering experiment station will greatly benefit the people in general through the development of the natural resources of their respective States. It will aid in the promotion of the mining, manufacturing, and other industries concerned in the utilization of these natural resources and likewise dependent upon a highly advanced state of engineering science.

It will serve to increase our commerce and trade abroad. It will open up still further the foreign markets of the world to the products of American industries. It will enable us to maintain our present high standard of excellence in these lines. It will enable us to advance the same beyond the highest point of similar industries in other nations in which such aid is not given to the development of engineering science.

In coordinating such engineering experiment stations with existing State colleges or universities they would afford increased facilities for instruction in experimental engineering and the post-graduate work of accredited engineers. The publication of bulletins, quarterly or oftener, would diffuse the work of the station among the

people and give practical information on engineering science and the State's resources for industrial development.

This paper was discussed in some detail by Messrs. R. H. Thurston, O. P. Hood, A. Kingsbury, C. F. Allen, J. A. Myers, W. F. M. Goss, H. W. Tyler, L. S. Randolph, and G. H. Hamlin. Approval of the work done by Professor Aldrich and his associates in the interest of the engineering bill was expressed, but it was decided not to bring the matter before the general convention.

Other papers presented were "The engineering laboratory in its relation to the public," by W. F. M. Goss, of Indiana; "Bicycle dynamometer tests," by C. A. Perkins, of Tennessee; "Mechanic arts in the schools of the South," by H. C. Powers, of Florida; "Shop courses in relation to engineering education," by L. S. Randolph, of Virginia. The last paper created an interesting discussion.

INDEX OF NAMES.

INDEX OF SUBJECTS.[1]

[1] Supplementary to Table of Contents, page 3.